The FOUNDRY

Volume 51
Number 1

Published
Semimonthly

CLEVELAND, OHIO, JANUARY 1, 1923

Castings for Heat Radiation

Standardized Castings of Many Shapes, but All Conforming to Definite Specifications Including Ability to Resist Pressure from Steam and Water, Are Made in Large Quantities

BY PAT DWYER

IN THE early days of the radiator business when the successful production of castings depended almost entirely upon individual skill, a tradition prevailed among outside shops to the effect that the radiator molders had the ends of their fingers ground on the emery stone every morning to insure the proper degree of sensitiveness. On account of the comparatively thin metal section in the castings, it was essential that the sand, particularly in the cope part of the mold should be rammed uniformly and it was argued that the average molder with calloused finger ends was tempted to finger-tuck the sand too hard under the bars. An extreme version of the story had it that when a man without previous radiator experience secured a job in one of these foundries, he had to submit to a surgical operation whereby the tips of all fingers were removed at the first joint. He was

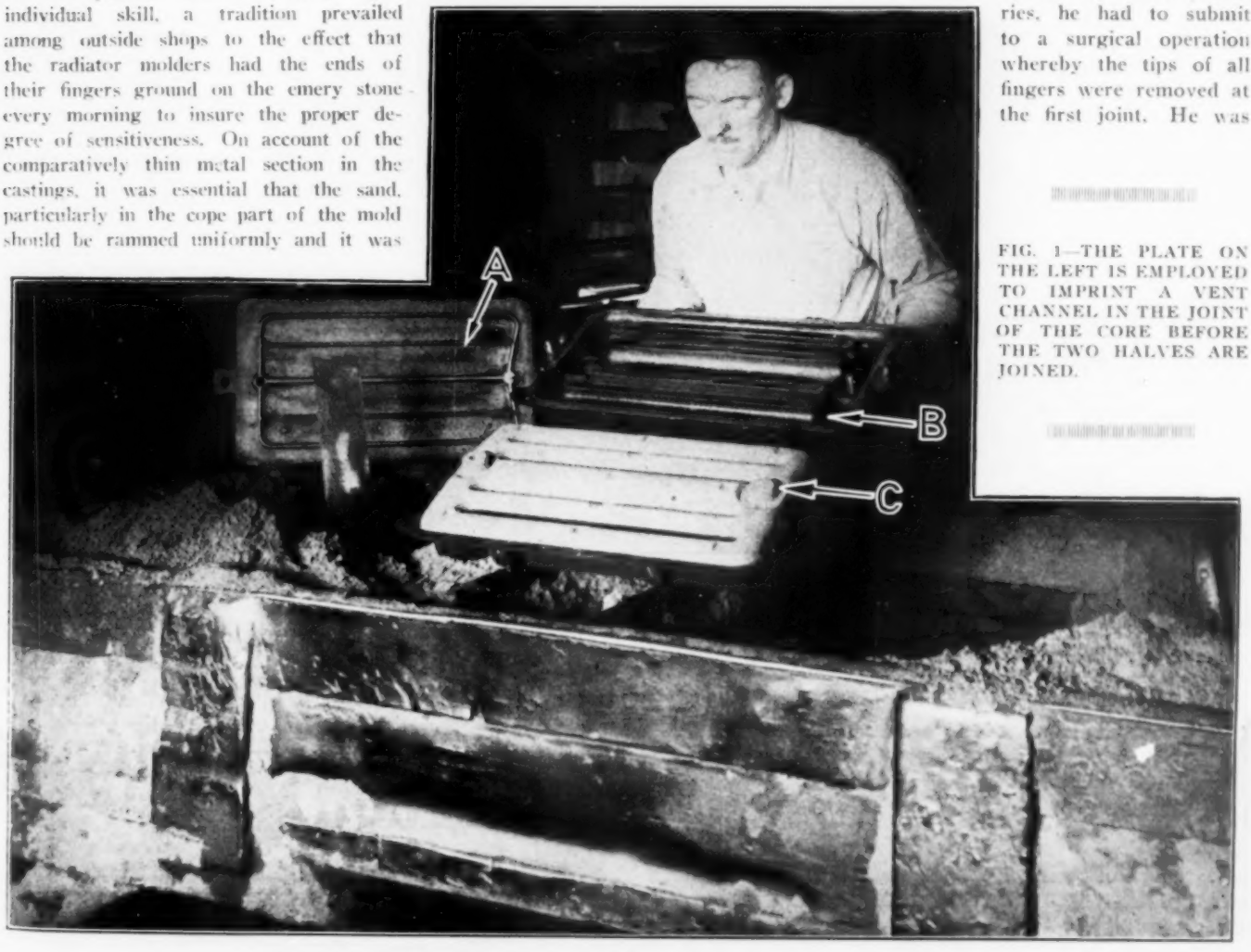


FIG. 1—THE PLATE ON THE LEFT IS EMPLOYED TO IMPRINT A VENT CHANNEL IN THE JOINT OF THE CORE BEFORE THE TWO HALVES ARE JOINED.

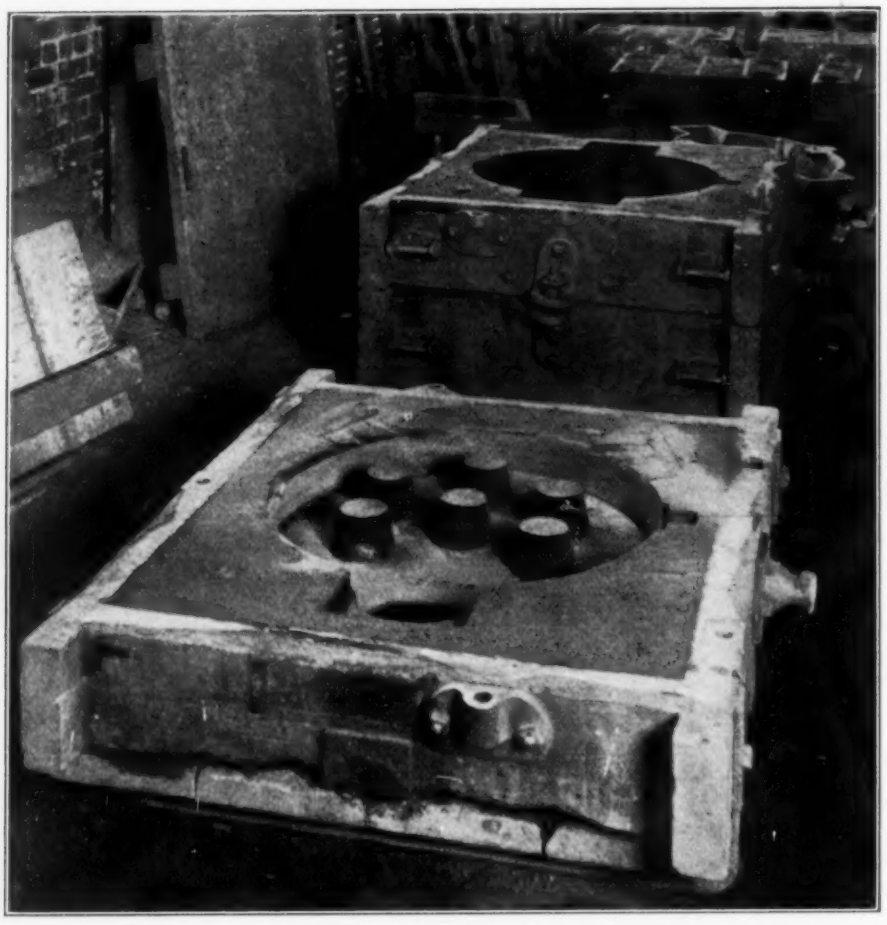


FIG. 2—AN IRON PLATE PREVENTS THE FLAME EMERGING FROM THE VENT HOLE FROM SETTING FIRE TO THE WOOD FLASK

placed at work immediately after the operation with the reasonable certainty that he would not tuck his bars undu'y hard for at least a month and by that time he would have developed a light and delicate touch that would remain with him as long as he remained on the job.

In common with many other foundry traditions, the foregoing probably is slightly exaggerated; but it illustrates the point that the individual skill of the operator was the controlling factor in the production of castings. The manufacture of radiator and boiler castings still is a highly specialized branch of the foundry industry, but the improvements introduced in recent years have been along the lines of providing better and more accurate equipment, more suitable buildings, and mechanical methods of handling the various loads, rather than in any attempt to improve the skill of the operators.

By this it is not meant to infer that these molders are recruited haphazard or that green help can be broken in to make these castings after receiving one or two lessons. However, many of the dangerous pitfalls have been removed and automatic safety devices have been introduced to a considerable extent. So many variables enter into the production of castings that a reasonable amount of scrap is recognized as inevitable in every heat. Even under practically similar conditions, the amount of scrap will vary from day to day. An infallible process by which every mold will produce a perfect casting has yet to be discovered, but in recent years many foundries, particularly those in which standardized methods have been applied to a

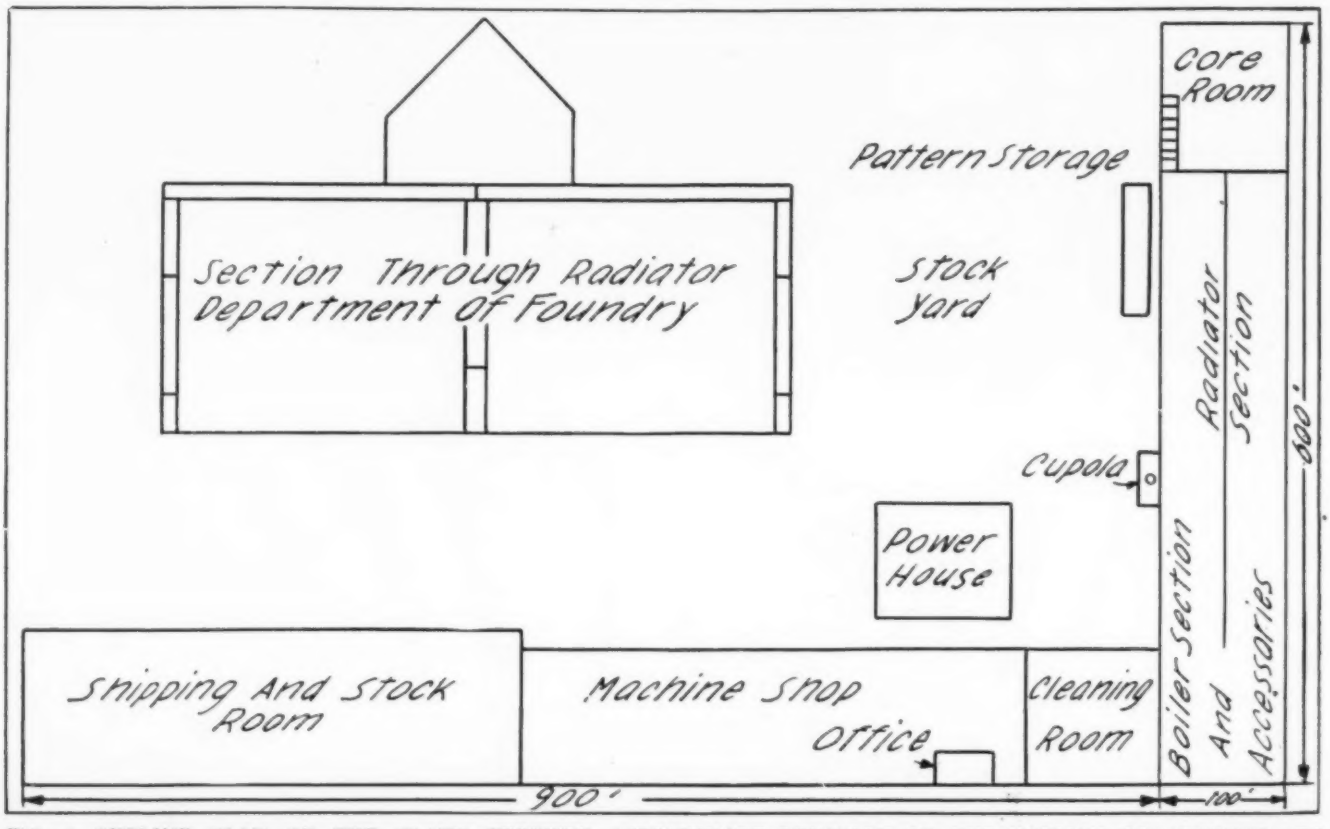


FIG. 3—OUTLINE PLAN OF THE PLANT SHOWING APPROXIMATE RELATION OF THE VARIOUS DEPARTMENTS TO EACH OTHER, WITH A SECTION THROUGH THE RADIATOR DEPARTMENT

staple product, have reduced their scrap percentage to a figure at one time thought impossible.

An interesting example of a manufacturing plant engaged in the production of castings for steam and hot water heating purposes is the Gurney Foundry Co., for many years located on Border Street, East Boston, but for the past 10 years housed in a well laid out plant at Framingham, Mass. Joseph G. Holfelder, connected with the company for many years in the capacity of foundry manager, personally supervised the layout and construction of the new plant. An outline is shown in Fig. 3 where it will be noted that the foundry and machine shop extend at right angles to each other, but that they join each other at the point of intersection. The foundry building is 100 feet wide, the machine shop building is the same for the greater part of its length and about 10 feet wider in the shipping and stock department. The foundry represents an overall length of 600 feet while the machine shop building, containing as it does several departments, measures 900 feet from end to end. The illustration shown in Fig. 3 is only an approximation to show the relative position units and is not drawn to scale. The sectional view to the left in Fig. 3 shows the style of roof supported on wide steel beams extending from the side walls to a row of steel columns in the center of the building. A concrete wall, 6 feet high connecting the center columns, extends through that part of the foundry devoted to the radiator molds. The remainder of the floor where boiler sections are made is divided into smaller units by four rows of columns which support the runways of the pneumatic cranes. The flasks in the radiator section all are comparatively light and may be handled by hand, but the greater number of the flasks employed on the boiler sections require the service of a crane.

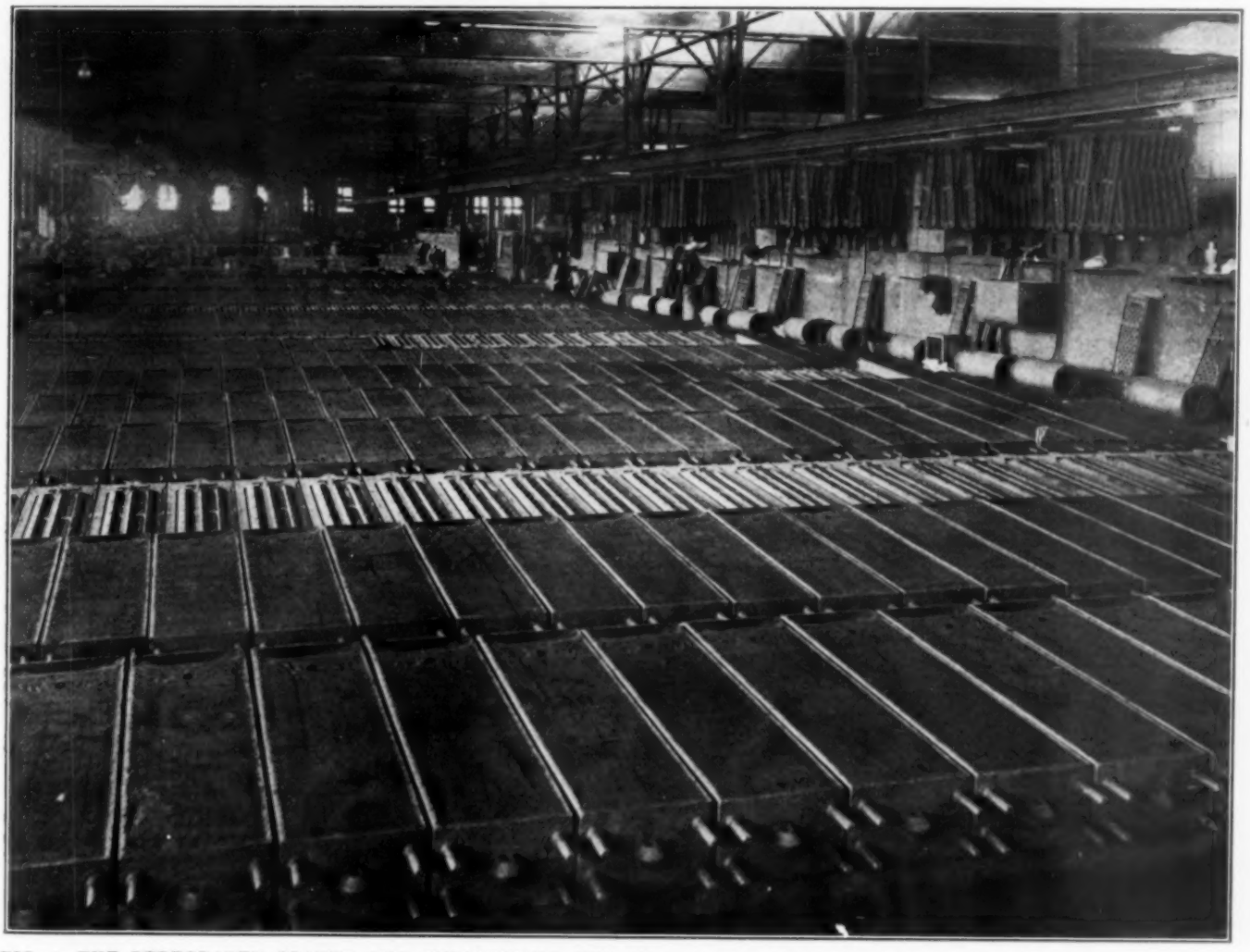


FIG. 4—THE PERFORATED PLATES AND CYLINDRICAL WEIGHTS SHOWN AT THE RIGHT ELIMINATE THE NECESSITY FOR BARS IN THE COPES OR CLAMPS TO HOLD THE FLASKS TOGETHER

Flow of Material

From the layout it will be noted that the flow of material constantly is in one direction with no back tracking or rerouting, a measure which makes for economy, speed, absence of confusion and increased production. A monorail system installed by the J. W. Paxson Co., Philadelphia, extends above each gangway and suitable carriers are provided for transporting sand, cores, castings and molten iron to any desired point. For example, the cores for the radiator molds are brought in on trays from the coreroom and then hung on long arms projecting from the center wall in front of the various radiator floors as shown at the upper right in Fig. 4. The supply is replenished from time to time and a surplus is kept on hand so that the molders will not be kept waiting at any time during the day's work. Usually the cope and drag of the mold are made on the same machine and from the same pattern, with the single exception that the detachable gate pieces are adjusted for either the upper or lower half of the mold. The customary practice is to make all the drags first, then set the cores and afterward make the necessary change in the pattern plate before ramming the copes and setting them in place on the drags.

Taking the departments in regular sequence as they appear on the layout Fig. 3, the first is the coreroom

shown in the upper right hand corner. A spur track, not shown, extending to the main line of the Boston and Albany railroad, passes close to the end of the building. Cars loaded with core sand are spotted close to the end of the building and unloaded by a mechanical device which lifts the sand in buckets attached to an endless belt and deposits it in a pile adjacent to one of the entrances to the coreroom.

Cores employed in the manufacture of heater castings must conform to certain definite and rigid specifications. In the mold they are almost entirely surrounded by iron and therefore it is essential that the gas generated shall escape freely through the limited number of available exits. They must be strong to prevent distortion in shape or position from the pressure exerted by the molten iron. They must crumble readily after the castings are poured to facilitate their removal during cleaning. The usual method of reinforcing cores by rods or arbors is not permissible here because it would be difficult if not impossible to remove them from the castings through the small openings provided for steam or hot water connections. Where large numbers of duplicate castings are made daily it is apparent that the cores must be uniform and exact duplicates of each other in every particular. Finally on account of the thin metal section presented by all castings of this character, the core must be extremely accurate in all dimensions. Materials and equipment provided in this core room are responsible for turning out cores that measure up to the foregoing specifications.

A fairly open grade of sharp sand, known under various names in different parts of the country as sea sand, beach sand, bank sand, river sand, washed sand and probably other terms, is employed, mixed in the proportion of 60 parts of sand to 1 part of an oil binder. All broken and defective cores are reduced to a coarse powder in a small tumbling barrel and the resulting product is incorporated in the core sand mixture prepared in a paddle type mixer made by the Standard Sand & Machine Co., Cleveland. The sand is fed to the mixing trough by a bucket conveyor and discharges through an opening about 3 feet above the floor, either into a pan suspended from the monorail, or into a wheelbarrow by which it is conveyed to the various core making stations.

Cores Dried in Shells

A smooth level, concrete floor covers the core room area embracing approximately 100 x 150 feet, with the exception of a space about 10 feet wide and 100 feet long extending in front of the core ovens as shown in Fig. 5. A typical radiator core making outfit is shown in Fig. 1 in which *A* represents the vent plate, *B* the cope half of the corebox, and *C* the drag which also serves as the dryer or shell in which the core is supported until it is baked and ready for the mold.

In practice, both halves of the corebox are placed face up and side by side on the two narrow supports extending from side to side of the box containing the supply of core sand. The operator fills both boxes with two sweeping motions of his shovel, presses the sand down lightly with his hands, then scrapes the surface off flush with a short straightedge. The vent plate, *A*, is lowered into place above the joint of the corebox, *B*, containing the guide pins. By bringing it down smartly an imprint of the projections on the plate is made in the face of the core joint which later will serve as channels for the free passage of gas generated during the pouring process. The vent plate is removed and then both halves of the corebox are turned up on edge, face to face, close together and lowered back on the supports with the part, marked *C*, underneath. The upper half *B* is removed and made ready for the following core, the part marked *C* containing the com-

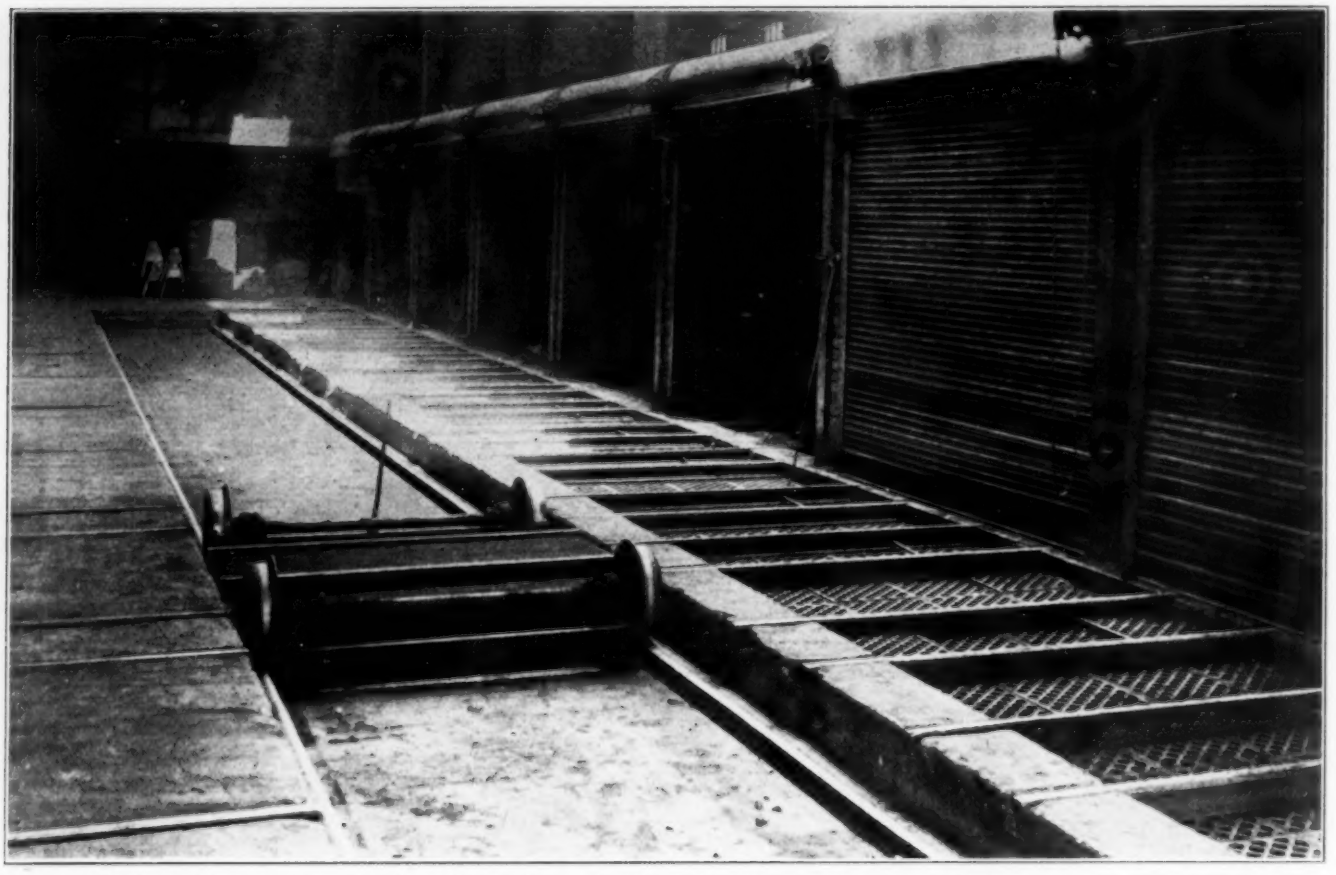


FIG. 5 PERFORATED PLATES SUPPLY LIGHT AND AIR TO THE TUNNEL IN FRONT OF THE FIRING CHAMBER ON THIS BATTERY OF EIGHT COKE FIRED OVENS

plete core is loaded on a rack and later, after the rack has been loaded to capacity, is placed in the core oven and dried.

The battery of eight double track core ovens erected by the company itself and the depressed transfer track and car by which cars may be switched to any oven are shown in Fig. 5. The cast iron floor grating immediately in front of the doors permits the free entrance of light and air to a tunnel in front of the firing chamber of the ovens. Coke is used for fuel in a fireplace which discharges its heat through a row of openings in the floor of the oven between the two car tracks. Suitable openings provided with dampers are located in the four corners of the floor. In practice the heated air first ascends between the two carloads of cores. When it strikes the roof it is deflected to both sides and is drawn down along the side walls toward the openings in the corners of the floor. In this manner a draft is created that carries the steam out of the oven. When the oven tender is satisfied that the steam has been exhausted, he closes the dampers and raises the temperature of the oven to a degree that will oxidize the oil to the proper extent. This feature exercises an important bearing on the subsequent case or difficulty experienced in cleaning the cores out of the castings. The ideal condition is one in which the core assumes a maximum degree of strength, but in which a few more degrees of heat would cause disintegration. Where this condition is attained the molten metal supplies the extra heat and the core can be rapped out of the casting in a loose stream of sand.

Many cores for the boiler sections are made in forms and dried in the same manner as the radiator cores. Practically the only exceptions are the cores for the flat sections, both round and rectangular. These are made in metal coreboxes, rolled over on flat iron plates and dried in the usual manner. The methods pursued on this class of cores has been standardized to a considerable extent and practically is the same in all foundries where heaters are made. A detailed description of how the cores are rodded and vented was published in the THE FOUNDRY April 1, 1922, page 267.

Brass Heaters

Three coke fired pit furnaces located at one end of the coreroom supply all the metal required to fill occasional orders for brass heating units employed in connection with hot water installations.

Practically half the floor space in the foundry, or all that part between the cupola and the core room, is devoted to the manufacture of radiators. As stated previously this part of the building is divided longitudinally by a 6-foot concrete wall connecting the center row of columns. The radiator floors on one side of the wall are shown in Fig. 4. The space on the other side of the wall presents a similar appearance. The floors extend from the side wall to the center in each case, the only difference in the layout being that in the side shown, the gangway adjoins the center wall, while in the side not shown, the gangway adjoins the side wall of the building.

The plain, hand-ram, stripping-plate, molding machines and others without the stripping feature are located permanently close to the wall and the molds are laid down in straight rows beginning at the gangway in each case and working back to the machine. The floors are prepared in a special manner so that the top surface of the flasks will present an even plane. This arrangement was prompted from several motives, but principally to facilitate shifting the weights as each successive flask is poured. Instead of bars in the cope to prevent the iron from pushing the sand up through, and clamps to hold the two halves of the flask together, a much

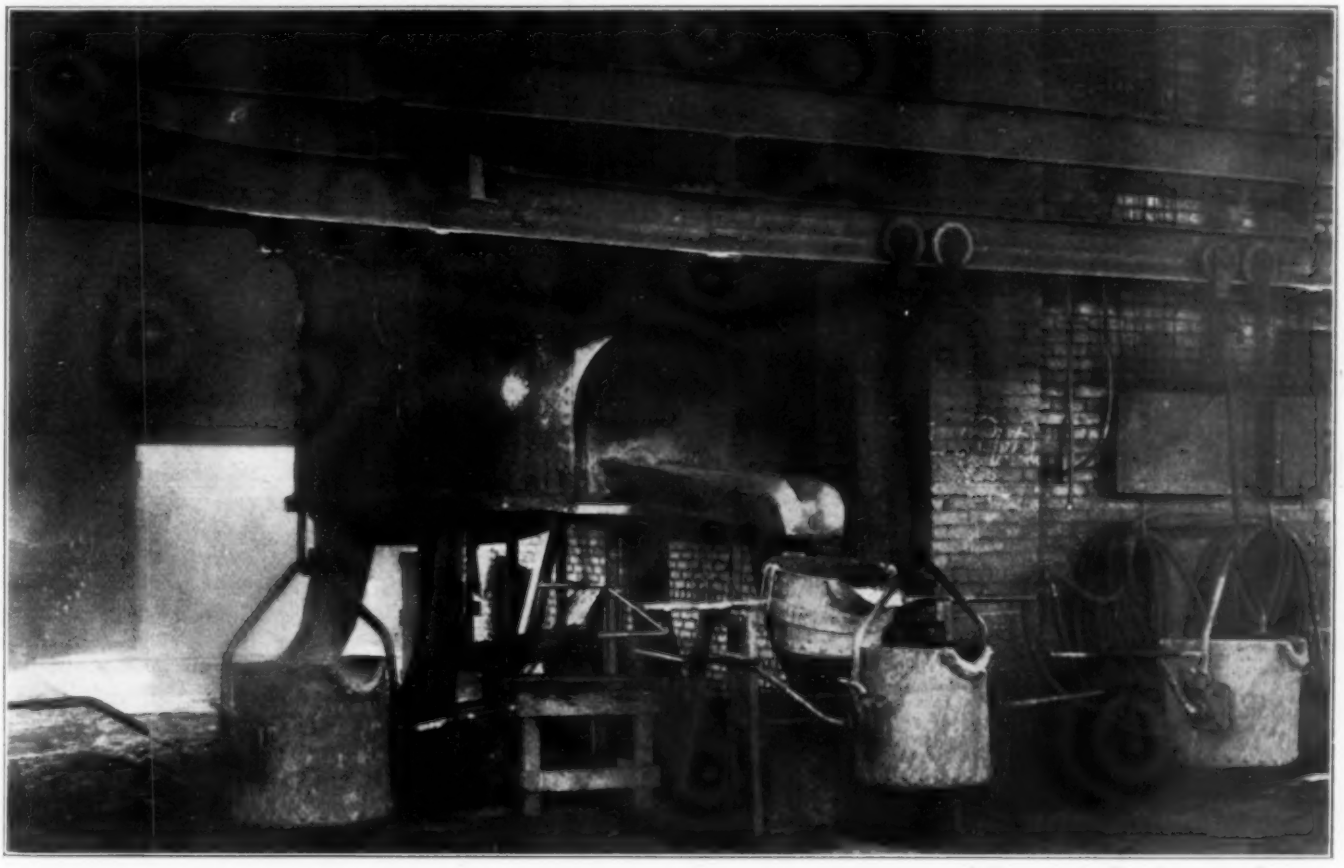


FIG. 6—THREE 1000-POUND LADLES AND ONE SMALL MIXING LADLE SERVE TO DISTRIBUTE 15 TONS OF IRON AN HOUR FOR 3 OR 4 HOURS EVERY DAY

FIG. 7—THESE FIRE POTS ARE MADE TWO AT A TIME IN AN IRON FLASK SPECIALLY DESIGNED FOR THE PURPOSE—OTHER POTS OF THE SAME GENERAL DESIGN ARE MADE ON EDGE IN ORDINARY FLAT FLASKS

simpler method is employed on these radiator flasks. The cope and drag flask are alike in that neither is equipped with bars within the ordinary meaning of the term. Two or more tie rods spaced 12 inches apart and at a height that will just clear the pattern, hold the sides of the flask rigidly in line and at the same time do not interfere with the ramming. After the mold is closed, a perforated iron plate is placed on the upper surface of the cope and a cylindrical iron weight is placed on the plate. These plates and weights are shown in Fig. 4 leaning against the wall and lying in the gangway. The flasks are set close together, the plates touching along the edges and the weight is rolled from the top of one flask to the top of that following. In this manner one weight and two plates serve each floor.

When commencing to pour, the weight is placed on the flask nearest the gangway. As the pouring progresses the weight is rolled back. After the last mold is poured, the weight is rolled toward the gangway and dumped in place ready for the following day. In this manner the lifting and shifting of weights is reduced to a minimum and the flasks may be arranged closer together than if clamps were employed.

Two narrow concrete walls, reinforced with steel bands, constitute the boundary of each floor on which a row of flasks is laid down. The top of one wall is flush with the floor while the top of the second wall is elevated about 4 inches so that the flasks lie on an incline. They are poured at the high end from a hand ladle. In some instances where two short links are made in a single flask and also in the case of medium sized links, the flasks are set up on floors that are level both longitudinally and transversely. The same holds true for exceptional lengths that need to be poured from both ends.

Sand Floor Is Leveled

After the flasks have been shaken out and the castings removed, the sand is cut over toward the back of the floor. The sand between the two concrete strips is scraped off flush and serves as a bed on which to set down the drags. No bottom plates are used on the drags. The sand forming the bed is soft enough to permit the ready escape of steam and yet firm enough to prevent the castings from straining.

The two main gangways extending from end to end, one in the center and the other at one side of the foundry and also two gangways lying at right angles, one leading from the center gangway to the cupola and the other from the center to the cleaning room, are floored with checkered cast iron plates. As stated elsewhere the monorail extending above the gangway serves as the principal conveying medium, but a considerable bulk is transported on trucks operating on the level, straight iron gangway.

The cupola and accessories, charging floor, elevator, blower, etc., are housed in an addition located adjacent to the main building on the stock yard side as shown in Fig. 3. The cupola is situated about an equal distance from each end of the molding floor and in that manner the travel of the ladles may be regulated to better advantage than if the distances were uneven. This point may be appreciated better when it is stated that the three ladles shown suspended from the monorail and supplementing the small mixing ladle on the stands, are adequate to take care of a heat ranging from 50 to 65 tons and extending over a period of 3 or 4 hours. After the first iron makes its appearance, it is allowed to run for a few minutes. The iron is used to dry and heat the hand ladles. The tap hole then is stopped until approximately 2000 pounds of iron has accumulated in the well of the cupola. The tap hole is opened and under usual conditions is not stopped again during the

progress of the heat. A nozzle brick, containing a 1-inch hole is employed to form the breast. Experiments were conducted to determine the proper size of opening and it was found that a variation of only ⅛-inch in diameter affected the usefulness of the brick to such an extent that it could not be used. Where a brick with a ⅞-inch opening was used the metal did not run through as rapidly as it melted and it became necessary to shut off the blast periodically. Where the opening measured 1⅛ inches the iron ran out more rapidly than it melted and the hole had to be stopped periodically until the iron accumulated in the well. With a 1-inch opening the balance is maintained.

Slag from the Back

With the foregoing arrangement, no trouble is experienced in keeping the furnace clear of slag. The iron level is maintained a little below the slag hole and the slag flows in a constant stream until the last of the iron has been melted. The cupola lined to 60 inches was supplied by the J. W. Paxson Co., Philadelphia, and the same company also provided the greater part of the auxiliary equipment. The elevator was supplied by the Ridgeway & Son Co., Coatesville, Pa.

Iron charges are made up in 3000-pound lots, approximately of 50 per cent pig and 50 per cent scrap. This proportion varies from time to time depending on market and transportation conditions. The charges are made up on portable wooden platforms provided with skids and conveyed by lift truck from the yard to the elevator serving the charging platform. The iron, coke and limestone are charged by hand through two charging doors in the cupola. Coke is used in the proportion of approximately 1 to 9. Blast is furnished by a blower made by the P. H. & F. M. Roots Co., Connersville, Ind., driven by a 30-horsepower Crocker-Wheeler motor.

A small room on the ground floor adjoining the space occupied by the cupola blower and elevator is provided with a small oven for drying the ladles and also with two pieces of equipment for mixing facing sand. One is a centrifugal mixer made by Wm. Sellers & Co., Philadelphia, and the other is a gyratory riddle made by the Great Western Mfg. Co., Leavenworth, Kan.

Typical molds for castings made in the second main division of the foundry are shown in Figs. 2 and 7. The round mold is for one of the intermediate sections of a circular hot water heater, the other is for a fire pot for one of the rectangular type of heaters. In the flask shown in Fig. 7 two castings are made at one time. Other patterns of the same general design are molded singly on edge in ordinary rectangular flasks and in the usual manner. Nearly all the molds at this end of the shop are rammed by hand. The only exceptions are some of the plain flat pieces which are made on two plain jolt machines supplied by the Herman Pneumatic Machine Co., Pittsburgh.

Metal patterns are employed exclusively and iron flasks accurately machined and fitted are used for making all classes of castings with the exception of the domes. These castings are made in wood flasks by men working on a piecework basis. The floors on which the molds are made are equipped with pneumatic cranes which are utilized in lifting the flasks filled with sand and also in handling the metal and castings, but the men prefer to lift the light empty wood flasks by hand, rather than to employ the crane which would be necessary if iron flasks were in use.

The cleaning room occupies a space approximately 100 feet square in the corner where the two main divisions of the building meet. The castings enter at one side from the foundry and pass out through the other side into the machine shop and thence to the shipping room. The castings are cleaned in a battery of tumbling barrels comprising one small cylindrical barrel, two large square barrels and 12 medium cylindrical barrels approximately 24 x 48 inches. The barrels are arranged in two rows, one on each side of a central gangway and are served by a monorail system connecting on one side with that in the foundry and on the other side with a line extending into the machine shop.

After the castings are chipped and cleaned they are examined and water tested at a row of benches located near the wall along one side of the cleaning room. In addition to ample light which characterizes this department in common with all other departments of the plant, dust arresters attached to the tumbling barrels, tend to make the cleaning room a bright cheerful place in which to carry on the work It offers a marked contrast in this respect to many of the old time cleaning rooms.

The machine shop where the castings are bored, faced and fitted, the immense stock room in which at times the castings are piled to the roof the shipping facilities and the power house equipped with its own steam generating plant, all are thoroughly up to date.

Malleable Foundrymen to Meet in Cleveland

Robert E. Belt, secretary-treasurer of the American Malleable Castings association, advises that a joint meeting of the western and eastern sections of the association will be held in Cleveland concurrent with the annual convention of the American Foundrymen's association. The meeting probably will be held on Wednesday, May 2, and the technical program of the American Foundrymen's association malleable session will be arranged so as to meet the convenience of the members of both associations. This means a big week for the men of the malleable casting industry of the country who are particularly interested in manufacturing processes and the technical side of this industry.

States Research Has Been Successful

The inception, aims and accomplishments of the Electric Steel Founders' Research group are explained by its research director, Major R. A. Bull, in a paper presented at a recent meeting of the division of engineering, of the National Research council. It is pointed out that research is conducted in each one of the member foundries along lines decided on by the technical committee which meets every six weeks to discuss the progress of the different investigations and outline further work. The wide scope of the researches of the group is shown by the statement that so far investigations have been carried on relating to abrasives, annealing, core practice, facing sand, gas cutting, furnace practice, the elimination of slag from castings, and welding. Major Bull states that after a little more than two years' work the accomplishments may be summarized as follows:

Marked improvement in quality of product;

Considerable reduction in operating costs;

Formation of the research habit in each plant organization;

Stimulation to do better work exhibited by all who have responsibilities in production.

He added that the fact the project is successful and has a sound basis is demonstrated by the enthusiasm for continuing the cooperation, exhibited by hardheaded business men who continued it with unabated zeal during a period when production was accompanied by considerable losses monthly.

Buys Steel Foundry

The plant of the Driscoll-Reese Steel Co., Hamburg, Pa., has been bought at receiver's sale by J. A. Gilmore and John G. Thomas, formerly of the Crucible Steel Casting Co., Lansdowne, Pa. Messrs. Gilmore and Thomas will operate the plant as the Pennsylvania Electric Steel Casting Co. The plant, built in 1917 and first operated in May, 1918, has a 1-ton electric furnace. It produced small steel and automobile castings and had a capacity of 900 tons annually.

Seek to Maintain Quality-II

Closely Drawn Specifications Set Rigid Mark Which Must Be Attained Even in Production Work—Analysis Governs Melting—Research Brings Results in Castings Standards

BY H. COLE ESTEP
European Manager of THE FOUNDRY

FOUNDRIES catering to the machine tool trade must also meet closely drawn specifications and at the same time get out a large tonnage. In a foundry taken over by the Bullard Machine Tool Co., Bridgeport, Conn., the average daily output of castings per man was raised from 350 pounds to 1180 pounds through the application of intensive production methods coupled with a plan of paying wages which provides a bonus in addition to the hourly rates for increased production over a pre-determined standard. Quality standards cannot be maintained under any system of quantity production which does not provide good wages. In fact, in the most successful quantity production shops, where the highest grades of work are turned out, the men earn considerably more than they could obtain for similar work in most other shops. But since these high earnings are spread over an increased output, the wages per ton are usually less than the average. Thus in one Detroit shop, girl coremakers are earning about $4 a day, but through supplying mechanical equipment which reduced the maximum lift to 30 pounds, the production was increased 25 to 75 per cent and the coremaking cost reduced as much as 50 per cent despite the high wages.

At the Bullard foundry already mentioned the average output recently has not fallen under 1020 pounds of good castings per man per day, with a maximum in one week of 1360 pounds per day. This is on lathe beds, head stocks and other machine tool castings. Tests have shown that owing to the use of proper equipment and careful supervision this rate of production has not brought about any deterioration in the quality of the castings, which conform to high standards.

The American Society for Testing Materials' specifications for medium castings call for a tensile strength of 21,000 pounds and transverse strength on the arbitration bar of 2900 pounds per square inch. At the Bullard plant however the average tensile strength is 33,000 pounds per square inch and the transverse strength around 3960 pounds.

Beds for 24-inch vertical turret lathes conforming to these specifications are now molded in 14 hours, as against 28 hours before machine equipment was installed. The bed for a 36-inch vertical turret lathe which formerly took 32 to 34 hours to mold is now turned out in 16 hours, while a 42-inch bed formerly taking 42 hours is now made in 24 to 26 hours. The best time under the old system for the bed of a 61-inch boring mill was 56 hours. This work is now accomplished in 32 hours.

Where The Catch Comes

Many are the devices which the progressive manager of an American quantity production foundry develops solely for the purpose of protecting the quality of his output. This gentleman is pictured in the minds of some people as spending his days and nights exclusively on contrivances and schemes to squeeze a little more effort out of the workmen, or in urging an already overtaxed equipment to just a trifle higher speed in order that the precious tonnage chart may trend ever upward. Intriguing as this picture may be to the disciples of easy going methods, it does not reflect the facts. The modern foundry manager really devotes most of his thought to problems relating to the quality of his product, and to meeting specifications while at the same time keeping up a predetermined rate of production. Once the proper rigging is set up and put in motion it is easy enough to turn out a thousand automobile cylinder blocks a day. If this is all that were required no high priced foundry managers would be necessary. Where the catch comes is in turning out a thousand *first class* cylinder blocks a day. It is for doing this that the foundry manager draws his high salary. The writer knows of one shop in Detroit where as soon as each mold is made a sheet of clean white note paper is placed over the runner to prevent any small particles of dirt from being brushed into the cavity. Very likely the resulting castings would be just as good if this detail were omitted, but these clean sheets of paper serve to remind every man in the shop of the necessity for taking care. They symbolize the ideals of the management, which are focussed not on merely getting out the work but on getting it out *right*. And in working toward this end the psychological value of these sheets of paper is considerable. They aid definitely in getting out a better grade of castings.

But the struggle for quality in the foundry is handicapped by the fact that in most directions it is not possible to work objectively. The real worth of a casting depends in the last analysis on the hidden action of the melting furnace and on invisible elements in the metal mixture which determine the strength, elasticity and resistance to wear of the final product. Therefore in a properly run quantity production shop the metallurgical department is of paramount importance. Results are what count, and results depend on the metal. Chemical control of melting practice, coupled with patient research into metallurgical mysteries, are almost invariably found in American foundries of the better sort.

One foundry making soil pipe on a large scale is able to maintain high standards along with the production of 300 tons per day, according to George K. Elliott of the Lunkenheimer Co., Cincinnati, by having a chemical laboratory located right at the cupolas analyzing every ladle of iron individually including determinations for carbon. This continuous analytical control makes it possible to detect immediately any tendency to diverge from the predetermined standards of quality, these divergencies being corrected before they have become serious.

Nor is the scientific control of the metal, right in the foundry, confined to chemical analysis. For instance in another foundry cited by Mr. Elliott, pyrometers are being used to determine the temperature of the molten iron at the cupola, in ladles of various sizes, and at various locations in the foundry, with the result that by rearranging the location of the light and heavy casting floors, altering the sizes of the ladles, and the number of transfers of metal, the quality of the product is being vastly improved. Another foundry making rolls is using the optical pyrometer to determine the temperature of the metal as it flows from the furnace. The metal is then held in the ladle until it cools to the exact temperature at which the roll is to be poured. Malleable foundries are

also using the optical pyrometer for determining the pouring temperature.

More recently some of these foundries have begun to make preliminary chemical analyses of the malleable iron while it is still in the furnace, as in steelmaking practice, so as to control the composition of the resulting castings more accurately. In a certain steel foundry in America the metallurgist marks the temperature at which the steel shall be poured, on a board which is prominently displayed on the charging floor. The desired carbon content also is indicated on this board. When the heat is tapped out the metallurgist takes the temperature with an optical pyrometer and after the metal has been analyzed, both the

THE METALLURGIST WATCHES THE POURING OF THE TEST PIECES TO DETERMINE THE APPROXIMATE TEMPERATURE OF THE METAL

pouring temperature and the analysis are marked up on the board so that everyone in the shop can see how closely the melter has come to the specifications. This produces a certain amount of competition among the different melters, with satisfactory results. Still other foundries in the United States making iron as well as steel castings have been devoting a great deal of study to the electric furnace as a means of improving the quality of metal under tonnage production. In a certain foundry in Cincinnati the introduction of an electric furnace reduced the defectives of a certain pattern from 35 per cent to 3 per cent, at the same time increasing the strength of the iron 40 per cent.

It is not difficult in American shops to produce cast iron, to which no steel has been added, under the conditions of chemical control suggested here, with an average tensile strength of over 36,000 pounds per square inch. Almost any iron foundry metallurgist in the United States, in the better class of shops, has seen many hundreds of heats of iron of 16 to 17 tons strength. These irons are of course formulated to fulfill particular conditions and should not be compared seriously with the product of many jobbing foundries catering to trades in which quality is not a desideratum.

It has been possible to put the large scale foundry operations of the United States on an exact basis largely through the fact that pig iron is sold exclusively by analysis. No American foundry purchases pig iron by fracture. Instead, the blast furnace furnishes a report showing the analysis of each carload of iron delivered. These analyses are sufficiently accurate so that the smaller foundries can use them for calculating their mixtures. While many of these foundries do not employ chemists, they almost invariably send samples regularly to outside chemists for analysis. Other small foundries are served by consulting chemists established in different cities throughout the country. These chemists furnish analyses of the product regularly and also send experts to the foundries by whom they are employed to establish and maintain correct melting practice.

Foundries large enough to maintain their own laboratory invariably test all heats chemically and physically. Some of these foundries analyze every carload of pig iron as it is received, but it is significant that others have found the blast furnace analysis to be so correct that they have dispensed with the routine analysis of the pig iron. All of them however test the coke for sulphur and ash, a maximum percentage of each being specified when the coke is purchased.

Besides the routine analysis of materials used and product made from day to day, the modern foundry chemist is usually busy with research work in order to improve the quality of his material and standardize the different mixtures, for most foundries use different compositions of metal and mixtures of iron for the several classes of castings which they make. Gray iron is regularly tested for transverse strength but as a general rule for tensile strength only in research work. Usually the engineer specifies the qualities he wants in the castings for the machine or device he is designing. The metallurgist then must control the mixture and the cupola so as to produce these results. In other cases the customer provides specifications which the foundry must meet.

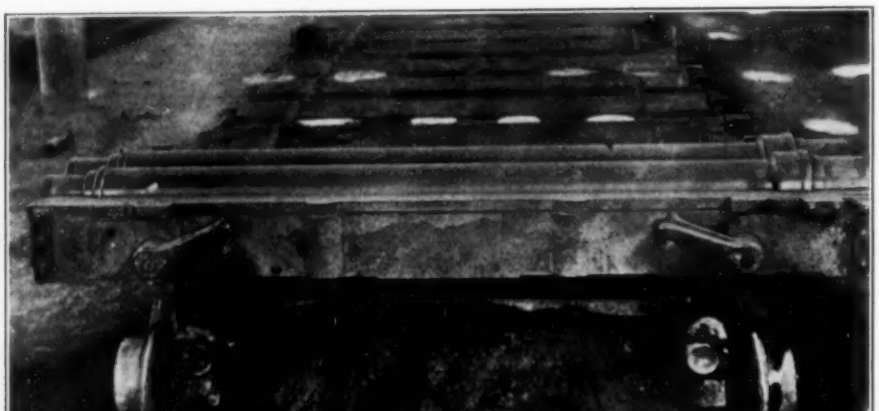
The General Electric Co., which has its headquarters at Schenectady, N. Y., has a number of foundries in different parts of the country and its procedure for controlling the quality of its castings is perhaps typical of the larger American organizations. At the different works a number of different metal mixtures are used as determined by the metallurgists at the respective plants. The different grades of castings must meet predetermined transverse tests. For this purpose test bars are cast from every mixture of iron used and tested regularly. While each foundry controls its own mixtures, a general foundry committee composed of the superintendents and metallurgists of all the foundries of the company meets regularly to discuss foundry problems and methods of improving the quality of the iron.

Some Actual Results

Another striking case of control and research directed from the same laboratory is found in the operations of the Niles Tool Works Co., Hamilton, Ohio. The laboratory of this company controls the daily mixtures much as in the case of the General Electric Co. In addition a large amount of special research work is done and the results of some of it have been indicated by the papers on slag control and microscopic study written by J. W. Bolton, the chemical engineer in charge of the laboratory, and published in THE FOUNDRY during the past few years. This company has a well thought out plan for research covering a number of years' work. It embraces a study of cupola operations including temperature investigations and analyses of the products of combustion, and also studies of the product put in and taken out of the cupola. The latter studies involve analyses, air measurements, investigation of heat losses and metallographic investigations.

In the automobile industry a large amount of work has been done investigating the characteristics of cast iron and developing methods of laboratory

control so that a reliable product may be made under quantity production conditions. That this work has borne fruit is shown by the records of the Cadillac Motor Car Co. The average cylinder iron produced by this company, according to H. B. Swan, superintendent of foundries, has a tensile strength of 35,000 to 36,000 pounds per square inch with a transverse strength on the arbitration bar of 3500 to 4000 pounds. The aim in making cylinders is to produce hard barrels of fine grain texture, using an iron free from segregation. A cylinder may be perfect and without a flaw as far as leaks, sandholes, blows, etc., are concerned but if the grain of the bore after it has been ground to a highly finished surface shows under inspection as being open or coarse the cylinder is scrapped. A portion of the pig iron used is smelted with charcoal in order to obtain metal of a pure quality. On a cylinder block recently examined which had given 40,000 miles' service the maximum wear was found to be 0.0015-inch. To get results of this sort the Cadillac company, among many other devices, uses grinding machines for finishing the surfaces of the cores, together with about 250 jigs for core assemblies which are absolutely interchangeable, made of metal, and cost about $50 per set. Every operation is gaged just as in a machine shop. The flasks are made of cast steel and the pins and bushings are ground to a thousandth of an inch.



WITH THIS RIGGING SOIL PIPE CAN BE MADE BY LABORERS, JUST AS WELL AS BY THE MOST SKILLED MOLDERS—THE PRECISION IS IN THE MACHINE AND NOT IN THE SKILL OF THE WORKMEN

The American automobile metallurgists feel that not only the amount but the condition of the total carbon is of prime importance for such work as cylinders. In fact the question of carbon is receiving just as much attention in American foundries as silicon, although this statement is contrary to the opinion advanced by an eminent British foundryman, F. J. Cook, in his paper read before the American Foundrymen's association last spring. The same is true of phosphorus and its occurrence in cast iron. Foundry chemists in the United States are now giving earnest consideration to problems connected with the occurrence of combinations of elements in iron such as phosphides, sulphides, etc.

In the automobile industry special metal mixtures are not uncommon. As an instance of special requirements H. B. Swan calls attention to an exhaust manifold which was polished all over the outside surface previous to a bake enamel. Being a thin-walled casting with some comparatively heavy bosses and flanges, considerable experimenting was necessary to obtain an iron which fulfilled all requirements satisfactorily.

Where more than one mixture is used Mr. Swan points out the necessity of keeping the different classes of remelt separate so that castings of uniform analysis may be obtained. In other words, the remelt must not be recharged indiscriminately as it is in a good many foundries. If this scrap is properly handled it is possible to vary and control the silicon, manganese, phosphorus and sulphur content easily.

The influence of molding practice on the quality of the metal must of course be studied. For instance in automobile cylinder work the sand in the water jacket cores and the large barrel cores holds the heat so long that the surrounding metal is annealed. This is counteracted by using hollow steel or iron arbors for the barrel cores covered with a thin layer from 3/16 to 5/16-inch of sand. A free circulation of air takes place under the bottom board, through the arbors and through the cope. This procedure will raise the hardness of the barrels from 30 to 40 points on the brinell scale. At the same time a low carbon is desirable and in most American foundries a cylinder containing from 0.50 to 0.60 per cent combined carbon and about 2.50 to 2.70 per cent graphitic carbon is preferable to one with the same percentage of combined carbon and over 3 per cent graphitic.

The effect of alloys in cast iron is of course being studied with the object of improving the quality of the metal and in certain American automobile foundries, pistons have been made containing 4 to 5 per cent nickel which when machined give a beautiful surface, extremely fine grain and a strength of 37,000 to 38,000 pounds per square inch.

To show that good results are really obtained under these conditions the writer will cite the testimony of one more American foundryman, R. S. McPherron, metallurgist for the Allis-Chalmers Mfg. Co., Milwaukee. In discussing Mr. Cook's paper, Mr. McPherron said that on a recent order which had passed under his observation, 82 sets of tensile bars cast for a certain job averaged 32,700 pounds per square inch and on another similar order 85 sets of tensile bars averaged 33,670 pounds. These bars represented all the tests made and were not selected for their high value. Furthermore they represented a medium grade of material, not the hardest iron made in the foundry but a material suitable for machining into cylinders, liners, etc. Transverse bars of this latter mixture have gone as high as 42,800 pounds. Two tensile bars cut from the bore of a liner for a 48-inch diameter gas-engine cylinder tested by Mr. McPherron broke at 36,080 and 36,480 pounds per square inch. This liner weighed about 5000 pounds with a metal section of 1½-inch. The brinell hardness was 183 on the finished bore. Another bar tested at the Allis-Chalmers works, cut from a full sized prolongation of a 44-inch cylinder liner, showed 37,960 pounds per square inch tensile strength. The hardness after machining was 192. This casting weighed 4300 pounds with a metal section of nearly 1½ inches.

Research Bears Fruit

In considering the character of the results obtained in American quantity production foundries the effect of cooperative research must not be overlooked. Perhaps the most classic example is found in the activities of the American Malleable Castings association with which the British metallurgical public is fully familiar. This association, which was organized largely through the efforts of John A. Penton and others, has practically transformed the American malleable castings industry from the standpoint of quality of product. The association was organized for the specific purpose of improving the quality of American malleable iron. How well it has succeeded is fully set forth in the able papers of Enrique Touceda presented at various times before the American Foundrymen's asso-

ciation, and this year before the Institution of British Foundrymen. Professor Touceda's published data show that starting in 1915 with metal averaging 40,000 to 46,000 pounds per square inch tensile strength and an elongation of from 4 to 9 per cent, it is now not uncommon to obtain test bars of ordinary everyday metal averaging 50,000 to 55,000 pounds per square inch tensile strength with 17 to 25 per cent elongation. In a paper read before the American Foundrymen's association in 1920 Professor Touceda says: "We started with low ultimate strength and elongation and made many muffs as we raised the standard, but some weeks ago we received a standard tensile test bar among other excellent ones, which showed over 60,000 pounds ultimate strength and 33.5 per cent elongation." This work has been accomplished by joining some of the principal producers of malleable castings in the United States into an association equipped with co-operative funds for the purpose of pursuing scientific investigations into the quality of malleable iron. In addition, each member of the association submits test bars from his daily heats, and in cases where these bars show unsatisfactory results the practice of the shop in question is immediately investigated. The result is the maintenance not only of a high standard throughout the industry, but a uniformly high standard from day to day and year to year.

Almost equally important is the Electric Steel Founders' Research group headed by Major R. A. Bull, research director. The six member concerns, the Electric Steel Co., Chicago,the Fort Pitt Steel Casting Co., McKeesport, Pa., the Lebanon Steel Foundry, Lebanon, Pa., the Michigan Steel Casting Co., Detroit, and the Sivyer Steel Casting Co., Milwaukee, turned out 2,569,327 castings in 1920. These foundries use electric furnace melting exclusively. The fundamental idea underlying the work of the research group is the production of better quality steel castings and broadly speaking the results are obtained through the following means: Frequent meetings of group representatives; investigations authorized at these conferences and conducted at suitable plants; general inspections of each plant by the research director; transmission regularly of reports to and from the director; and the use of the director's office as a clearing house and distribution center for all technical information of value to the members.

To show how efficacious an organization of this sort is in improving the quality of the product, it should be pointed out that the research director, Major Bull, makes periodic visits to each plant, preparing reports on them in turn, copies of each of which are sent to all the members. He comments upon such items as shop appearance, safety precautions, economy in equipment operation; waste prevention, sand mixing and condition of facing, condition of molds and cores, furnace operation, condition and handling of metal while pouring, effectivenesss of annealing and welding, condition of castings when shaken out and when ready to ship, and efficiency and morale of the shop organization. No point which has to do with the welfare of the plant or the quality of its product is omitted intentionally.

These reports of general inspections have instilled into each organization in the association a spirit of healthy rivalry and striving after results. Like the frequent but irregular visits of bank examiners, these inspections by Major Bull furnish an incentive which keeps the working force of each shop on its metal, and in addition of course there is the scientific research work of the group previously mentioned.

Each plant in the group not only reports the analyses, etc. of its various heats to the director, but sends to him six sets of drillings from each heat. These drillings are sent to other plants in the group, accompanied only by secret key numbers, for analysis. In this and in other ways the analytical work is satisfactorily checked up and maintained at a high standard of perfection.

Effects Are Positive

The results of the policies of the research group are evident in many small details as well as in the main phases of foundry practice. For example, except where a customer stipulates a different procedure, all castings are carefully annealed; surface imperfections, even of slight extent caused by dirt or slag, are chipped out thoroughly before being welded, and except where because of frail design distortion might result, all castings are put through a tumbling barrel to give them a superior finish. Certain castings from each heat are systematically cut apart and machined to ascertain interior soundness and condition.

In other words, control all along the line is the answer and the only asnwer to the quality problem in a modern factory. In discussing gray iron foundry practice, H. B. Swan of the Cadillac Motor Car Co., previously quoted, has epitomized this conception in the following words: "With a full understanding of the relations of each element and their functions, together with close melting control, it is not difficult to run an iron mixture from day to day with a small variation in composition. Of course it is understood," Mr. Swan reminds us, "that accurate information is at hand concerning the composition of all the raw materials affecting the final product and that frequent analysis, hardness tests, fracture examinations, pouring temperature observations, and physical tests are necessary adjuncts to close control and desirable results." In the writer's opinion these remarks sum up the philosophy underlying the manufacture of a quality product under quantity production conditions. It is all a question of systematized scientific control with plenty of brains and ability on the side of the management.

Book Review

A Comparison of British and American Foundry Practice, P. G. H. Boswell; paper, 106 pages 5½ x 8½ inches, published by the University Press of Liverpool, Ltd., Liverpool, England, and furnished by THE FOUNDRY, Cleveland, for $1 net.

During recent years, it has been realized that the world is becoming more and more dependent upon the use of castings. Skill in foundry practice has been developed to such a degree that castings of 160 tons are now being made as well as the great variety of smaller sizes. Castings have steadily replaced structures built of other materials, and the heat treatment to which they now are subjected has made them suitable for use in many new and diverse ways.

Realizing the importance of the subject and the value to the British foundrymen of information gathered from foreign countries the author was sent to the United States in 1918 by the British Minister of Munitions to report upon American foundry practice, particularly with regard to the use of sands for steel molding. The investigation was conducted along three general lines. In the first group visits were made to iron, steel and brass foundries and conferences were held with managers, metallurgists and others concerned with the problems. In the second case the quarries and sources of raw refractory materials used in the industry were inspected. Visits also were made to universities and technical institutions likely to carry on research on the problems under consideration.

This book is a report of the inspection made of American industries. The last chapter is a comparison of the American and British methods. Tables showing the results of analyses made on samples secured during the visit in this country also are included.

Ingersoll-Rand Co., 11 Broadway, New York, with the A. S. Cameron Steam Pump Works has established a branch office at 718 Ellicott Square building, Buffalo, N. Y.

Foundry Problems Are Covered

Ohio State Foundrymen's Association Holds Annual Meeting Where Experts Discuss Questions of Live Interest—New Officers Are Chosen—Review Work of the Past Year

REPRESENTATIVE foundrymen from practically every section of the state attended the annual convention of the Ohio State Foundrymen's association held in Middletown, O., December 7 annd 8. The program included business and technical sessions followed by a banquet at the new Hotel Manchester on the first day, supplemented on the second day by as inspection of the extensive plant of the American Rolling Mill Co. Luncheon was served in the office cafeteria after which the members were driven to Cincinnati where the local foundrymen provided further entertainment.

Kenyon Riddle, city manager, Middletown, O., in welcoming the members of the association to the city compared the molding of character, morals and mental viewpoint with the familiar and age-old process of molding metals.

A. J. Tuscany, secretary-manager of the association in presenting his annual report directed attention to the fact that during the past year many business men had considered it advisable to relinquish membership in their various associations. In this respect the Ohio State Foundrymen's association was fortunate in that only four members had resigned, a loss that was more than offset by a gain of 35 members. Outstanding features of constructive work accomplished during the year included distribution of cost finding statistics with supplementary information on how the system could be applied in each member's individual plant. Uniform trades customs set of specifications has been placed in force, defining the relative duties and obligations of buyer and seller. Another set of specifications has been adopted in connection with pig iron contracts, designed to eliminate misunderstandings between foundrymen and the various interests supplying this commodity. One of the most important measures has been the engaging of a consulting actuary to interpret the workman's compensation law and to furnish expert advice on any proposed amendments or changes in the present status of this piece of legislation. Connection has been secured with various organizations engaged in supplying information on credit ratings, financial and general business trend and outlook. A monthly bulletin is issued showing the amount of iron purchased and contracted for, the labor situation, equipment available for exchange, list of executives, superintendents and foremen either at liberty or contemplating a change. Intimate touch is maintained with industrial legislation. A trouble department is available for the benefit of those who desire specific information on any phase of foundry operation, maintenance or adminstration.

New Officers of Ohio State Association

President

F. W. HUBER, re-elected, American Rolling Mills Co., Middletown, O.

Vice President

J. H. BRUCE, Bowler Foundry Co., Cleveland.

Treasurer

WALTER SEELBACH, Walworth Run Foundry Co., Cleveland.

Secretary-Manager

A. J. TUSCANY, re-elected, Century building, Cleveland.

Members, Board of Administration

F. W. HUBER, American Rolling Mills Co., Middletown, O.

G. W. PIEHL, Wessling Brothers Foundry Co., Cincinnati.

WALTER SEELBACH, Walworth Run Foundry Co., Cleveland.

W. E. MATTHEWS, Carroll Foundry & Machine Tool Co., Bucyrus, O.

L. H. WISE, Dockray Brass & Iron Co., Zanesville, O.

Electric Furnace Operation

Geo. K. Elliott, Lunkenheimer Co., Cincinnati, presented his views on the relation of the electric furnace to cast iron. In a briefly historical manner he traced the development of this type of melting medium in Europe, of its later adoption in the United States and to the further interesting fact that out of the approximately 1000 electric furnaces now in operation throughout the world 333 are in the United States. The second largest number in any one country is in Italy.

Before touching on the subject of melting iron in the electric furnace Mr. Elliott went into considerable detail on the difference between basic and acid lined furnaces and the reactions that take place in the manufacture of steel. The basic furnace is the more flexible in that practically any iron or steel may be charged and manipulated to conform to any desired analysis. In the acid furnace it is necessary to charge material of approximately the same analysis as the anticipated product. In an acid furnace the charge is melted on a silicia bottom while in a basic furnace the bottom is made up of magnesite and dolomite with magnesite brick surrounding the hearth.

Either hot or cold metal may be charged into the electric furnace, but since the electric furnace is relatively more expensive to operate than the cupola, clearly it is the part of economy to melt the iron in the cheapest medium and then if necessary, refine and superheat it in the electric furnace. This is known as the duplexing process and is the method practised in the plant with which Mr. Elliott is connected. The cupola is the cheapest and most efficient device ever developed for melting iron and in all probability never will be entirely superseded or abandoned. The iron as it leaves the cupola is satisfactory for a wide range of castings. Its only drawback is that the charge cannot be manipulated between the time it is placed in the furnace and the time it is tapped into the ladle. In addition, certain inexorable changes take place. For example, the silicon content will be lowered approximately 25 points, the manganese will be lowered an appreciable amount, usually about 25 points, depending on the component elements of the charge; under certain conditions the carbon content will be increased and the same holds true for the sulphur. The only element that remains constant is the phosphorus. Touching on the relative cost of actually melting the metal Mr. Elliott stated that one ton of coke at present Cincinnati quotation of $15.00 will melt as much iron as 4000 kilowatt-hours of electric current at 1¾ cents per kilowatt-hour, or $70.00.

On a comparative basis it is claimed that the thermal efficiency of the crucible furnace is only 3 per cent, that of the air furnace 15 per cent, the open-hearth furnace 25 per cent, the cupola 40 per cent and the electric furnace 60 per cent. However, when the percentage of loss incurred in producing the electric current it taken into consideration, it will be seen that the high thermal efficiency is more apparent than real.

Taking up the different component elements of cast iron in turn Mr. Elliott pointed out that silicon practically controls the carbon content. Silicon is lost in the cupola while an acid furnace lining actually adds a little of this

element. The basic furnace may drop a little but it easily is replaced by ferrosilicon.

High manganese content is required in the cupola charge to neutralize the effect of high sulphur. The percentage of manganese is reduced about 20 points in the cupola. About 40 points is lost in the acid furnace but it may be replaced by ferromanganese. The basic furnace retains all the manganese in the original charge.

Phosphorus is regarded as a desirable element in cupola-melted iron, since it promotes fluidity. However, it makes the iron brittle and therefore is undesirable where strength and toughness are required. The electric furnace is capable of superheating the iron to a point that renders it more fluid than could be attained by any amount of phosphorus. The temperature in the cupola rarely exceeds 2500 degrees Fahr. while the temperature that may be attained in the electric furnace is only limited by the refractory qualities of the liming. The phosphorus content remains the same irrespective of whether it is melted in a cupola or electric furnace.

Iron increases in sulphur each time it is melted in the cupola. The acid furnace offers no relief in this respect, but in the basic furnace sulphur practically may be reduced to the vanishing point. From his records Mr. Elliott presented figures to show that in one heat sulphur was reduced from 0.156 per cent to 0.014 per cent in 64 minutes and on an experimental test the sulphur content was reduced to 0.009 per cent.

Pat Dwyer, engineering editor, THE FOUNDRY, discussed some of the practical feaures of cupola operation. He dwelt on the utter lack of uniformity that seems to prevail among foundrymen on a process amenable to standardization. Iron and coke are wasted and unsatisfactory melting conditions obtain to a great extent, not from lack of knowledge on the part of the executives, but on account of lack of close and intelligent supervision.

Rapid, economical and efficient melting in the cupola hinges on three factors: Supplying a sufficient volume of air to completely consume a given quantity of coke in a given time, proportioning the charges so that each layer of iron is melted by the time the underlying layer of coke is consumed and adding a suitable quantity of fluxing material to each charge to unite with the ash of the coke and other impurities and carry it away in the form of slag that will flow freely. Mr. Dwyer concluded his address by a description of how a cupola should be prepared for a heat.

A. J. Tuscany, secretary-manager of the association warned the members of the evils of price cutting. He also directed attention to the fact that prices of raw material and labor are advancing and advised against taking orders for future delivery based on today's prices.

Developing Foundry Material was the subject of a paper presented by J. H. Hogue, foundry superintendent, French Foundry Co., Piqua, O. This paper is abstracted in this issue.

Mr. Thompson, Dayton Pneumatic Tool Co., Dayton, O., read a paper on the proper maintenance of pneumatic tools.

Frank D. Chase, Frank D. Chase Inc., engineers, Chicago, delivered an address illustrated by lantern slides at the session following the banquet Thursday night. He pointed out that industrial conditions are changing and the only way to stay in the procession is to cut production costs. The building in which operations are carried on is as much a piece of equipment as any of the other accessories and as such it should be designed carefully to fulfill a certain definite functioin. The selection of a suitable site probably is the most important item of the many governing any enterprise. Mr. Chase furnished several illustrations to prove lack of proper selection in this respect later added enormously to the cost of operation of a castings manufacturing plant.

Developing Material for the Foundry

BY J. H. HOGUE

SHORTAGE today of competent men in our foundries, in the executive forces and also in the ranks of manual labor means that both classes must be developed. The only method available, so far as I can see for recruiting the latter class is to clean house, build modern foundries, equip them for convenience and comfort of the employes and in other ways make the profession attractive. The man doing manual labor today demands a higher standard than formerly obtained in his working conditions and if he cannot find it in the foundry he will seek other places of employment.

Numerous educational institutions which include in their curriculum a course in foundry practice are available for the purpose of training men who are fitted to become foundry executives. However, in my opinion, some of these are only play houses while others are in charge of men who also teach additional subjects such as wood working and blacksmithing. Some melt iron and others do not. Some have no modern equipment of any kind. One is the proud possesser of four different types of molding machines, one power operated and the remaining three operated by hand. I only have seen one housed in a building constructed purposely for a foundry. Two are equipped with cranes and are far superior to any of the others. One stresses practical instruction and the other's strong point is theory and management.

The foundry in Ohio State university is situated on the first floor of a two-story building 50 x 100 feet. About one-third of the floor space is cut off by a solid partition which shuts out all light from one side. The equipment includes a 22-inch cupola, a core machine made by the Wadsworth Core Machine & Equipment Co., Akron, O., a core oven supplied by the Millett Core Oven Co., Springfield, Mass., one handpower squeezing molding machine made by the Adams Co., Dubuque, Iowa, one gas fired melting furnace made by the Iler Mfg. Co., Cleveland and a number of small steel flasks. All the castings made would be classed as bench work.

The average enrollment in the class for the past five years has been 75. The course is only required of those students taking mechanical engineering. It covers a period of 80 hours, partly devoted to lectures and class room work and the remainder to actual shop practice.

Institutions of this kind do not pretend to supply trained men to the trade. They simply familiarize the engineering student to some extent with foundry practice. With few exceptions the time allotted to the work does not extend over a period of 30 days. From the foregoing it is apparent that little relief may be expected from that quarter.

I favor the establishment of a special school for training men of the type most needed in the commercial foundry, both today and in the future. The course of instruction should be available for the engineering student at the university and also serve

From a paper presented before the annual convention of the Ohio State Foundrymen's association, Middletown, O., Dec. 7-8. The author is foundry superintendent of the French Foundry Co., Piqua, O.

as an advanced course for any other person who desires to take it up.

Many advantages follow from locating at the university. For example, a student in mechanical engineering would have the opportunity of majoring in foundry practice. Courses in mathematics, chemistry, metallurgy and metallography are available and naturally would form a part of the proposed course. In addition the student would absorb the university spirit which in itself makes for leadership. I see no reason why a student majoring in foundry practice should not be given a degree of foundry engineer, in the same manner that other students eventually acquire degrees in other branches of engineering.

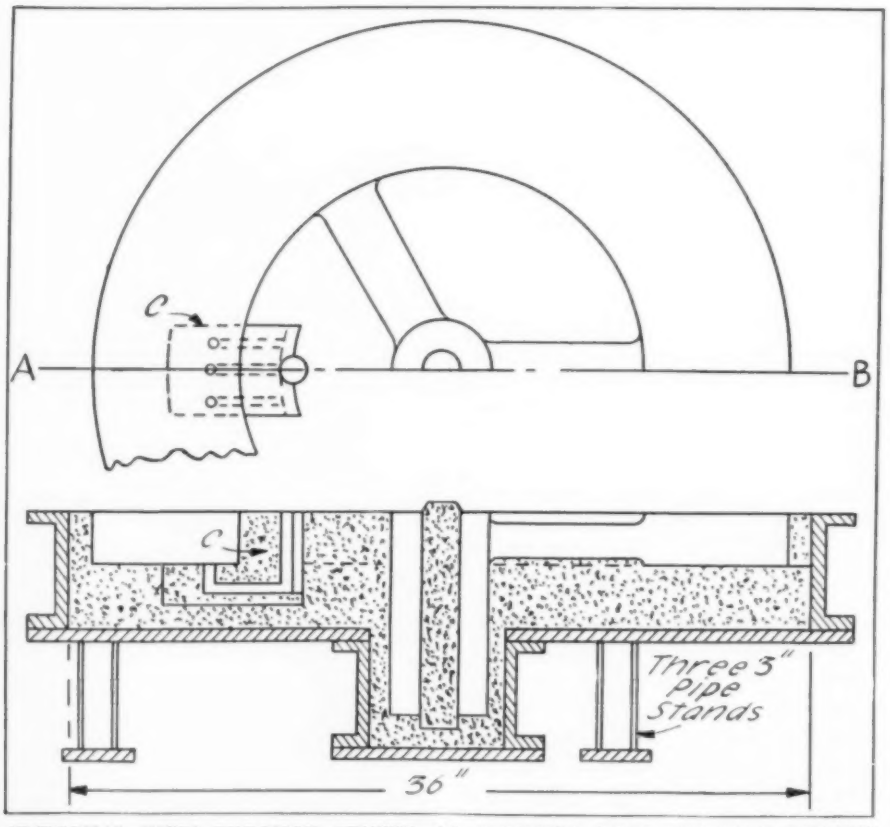
The foundry and equipment should be of such a character that the instructor should have no occasion to say—as many are forced to say at the present time—"This is not the proper way to handle the job, but we are compelled to do it this way for lack of suitable facilities."

Funds for supporting the institution might be supplied by the foundrymen of the state and if a meeting was arranged between the administrators of the university and the Ohio State Foundrymen's association, no trouble should be experienced in developing a plan for financing the undertaking in a satisfactory way.

Pencil Gates Applied to Friction Disk

BY W. H. ROESNER

IN AN interesting paper presented in a recent issue of THE FOUNDRY, E. V. Ronceray disclaims originating the idea in which he advocates the employment of small gates and the elimination of feeding heads on nearly all castings. He intimates that the method was practised many years ago and first was brought to his attention by M. Saillot who had adopted the method as far back as 1886 while acting in the capacity of foundry manager at the shops of the Western Railway Co. of France. I have no means of determining when the method first was introduced into America, but certainly it has been practiced to a considerable extent for over 20 years. My first actual experience was in 1907 when I applied pencil gates to various castings including a friction disk common to the older style of tractors. This casting was machined on both sides and the problem of securing a clean surface presented considerable trouble until the pencil gate method was applied. Thereafter the results were so satisfactory that no further changes were made in the gating system and the gate as shown in the accompanying illustration was employed until the pattern became obsolete. With the exception of a small pop riser which served to indicate when the mold was filled and also in a certain measure relieved the pressure, no feeders were attached to the casting.



SECTIONAL VIEW THROUGH CENTER OF FINISHED DRAG SHOWING RUNNER CORE C IN PLACE

After the comparatively plain face, 6-inch cope was set on, a small runner basin was built around the single down runner. The metal in the drag passed through a runner core provided with three small openings discharging up through the bottom face of the disk mold. The runner in effect was a variation of the well known horn gate provided with three outlets instead of one. The casting weighed about 400 pounds in the rough and it is apparent that the amount of scrap charged to gates and risers amounted to only a small portion of the total.

In this connection it is interesting to note that large paper mill rolls are poured on end through a number of small gates. These castings must present an absolutely clean surface which is highly polished before they are assembled in the calender frames and it has been found that a circular row of small pencil gates through which the metal drops directly down into the mold, produces the most satisfactory castings.

Engage in Foundry Consulting Practice

James F. Miller and Leonard E. Hurst, formerly connected with the Ford Motor Co., Detroit, have established an office in the General Motors building, Detroit, where they will engage in design and construction and organization of quantity production foundries. Mr. Miller, formerly was superintendent of foundries, blast furnaces and coke ovens at the River Rouge plant, while Mr. Hurst was engineer and superintendent of construction installation and operation of foundry equipment.

Plans Test to Define Sands-I

Research Made To Develop Standard Method—Measuring Length or Weight Broken from Bar Pushed Over Edge of Plate Found Impractical —Horizontal and Vertical Tension Tests Tried

BY R. J. DOTY

A LITTLE more than a year ago at the request of the Electric Steel Founders Research group, the Sivyer Steel Casting Co., Milwaukee, undertook an investigation of the facing sand problem. It was believed that in such an investigation comparisons of one sand with another would be essential, and it was felt that sands could not be compared unless some value could be given to them or to the properties which they possess.

The first effort was to decide upon those properties which were believed essential to a good facing; and the next, to define in some manner the extent to which any of the sands under investigation possessed those properties.

It was easy to decide the properties which should be compared, but to find tests which would determine accurately the degree to which any sand possessed these properties was a more difficult problem.

In testing the strength of any material, there are but two directions in which the force is commonly applied, namely in the direction of the principal axis or at right angles to it. For some materials the tensile test is the best strength criterion; for others, the transverse test finds the best application. Investigators of sand have chosen the latter, and have almost invariably determined the strength by pushing the test bar lengthwise over a plate until the overhang broke off under its own weight.

In preliminary experiments with facing sand used in the Sivyer foundry, the transverse test was first used, and it was evident that the density to which the sand was rammed would have a great effect upon the strength of the material. Since hand ramming was unreliable, a core box was so constructed that a volume of sand 10 x 1 x 1¾-inch was in each case compressed to a core 10 x 1 x 1-inch, the compression being entirely from the top by means of a ¾-inch projection to the cover which formed the top of the box. The box referred to, and a core made from it are illustrated in Fig. 1.

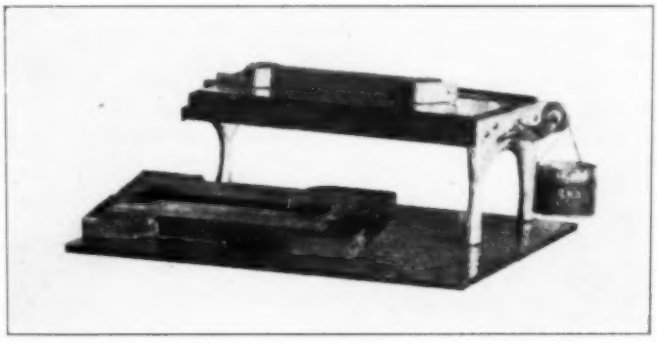
The box in this and following experiments was filled by pushing the sand with the fingers through a ¼-inch riddle, resting on the top of the box, any excess sand being removed before ramming by means of a glass plate used in the same manner as a molder uses a strike. The cover of the box was then forced into position, forming the core already described. After removal of the cover and the bottom, both of which were doweled to the sides of the

Table I

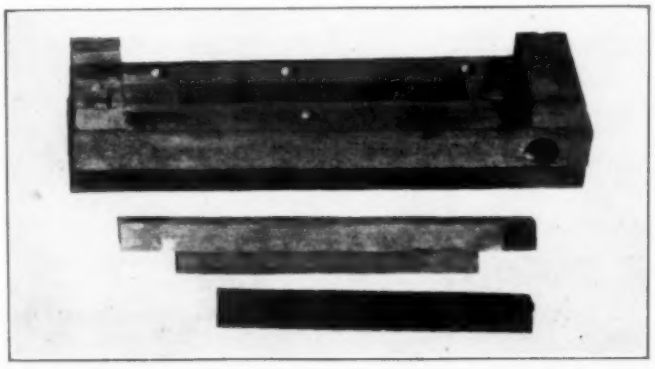
Length Broken Off in Overhanging Test

Bar	1	2	3	4
	Length of Section Broken Off—Centimeters			
Break 1	5.09	5.7	6.45	5.4
Break 2	5.09	5.16	6.20	5.08
Break 3	4.78	4.94	6.12	6.70
Average	4.99	5.27	6.26	5.72
	Maximum Deviation—Per Cent			
	4.2	8.2	3.2	17.5

Average maximum deviation—8.27 per cent.
Grand average—5.56 centimeters.
Maximum deviation—20.1 per cent.



Paper prepared for the Rochester meeting of the American Foundrymen's association. The author is vice president and works manager, the Sivyer Steel Casting Co., Milwaukee.



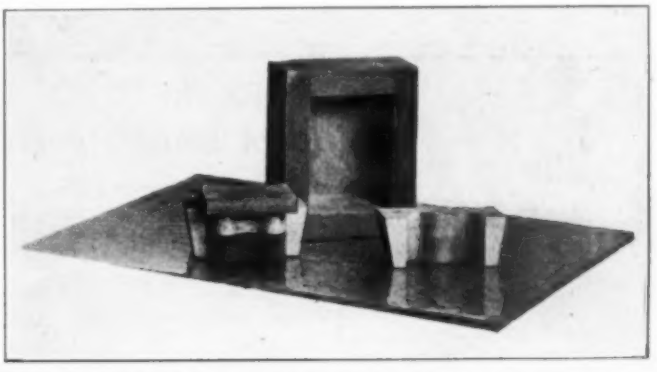


FIG. 1—COREBOX AND CORE FIRST USED IN TESTS FIG. 2—(ABOVE)—HORIZONTAL TEST TABLE SHOWING CORE AND CLAMPS IN PLACE FIG. 3—SHORTENED CORE RAMMED BY TOP COMPRESSION

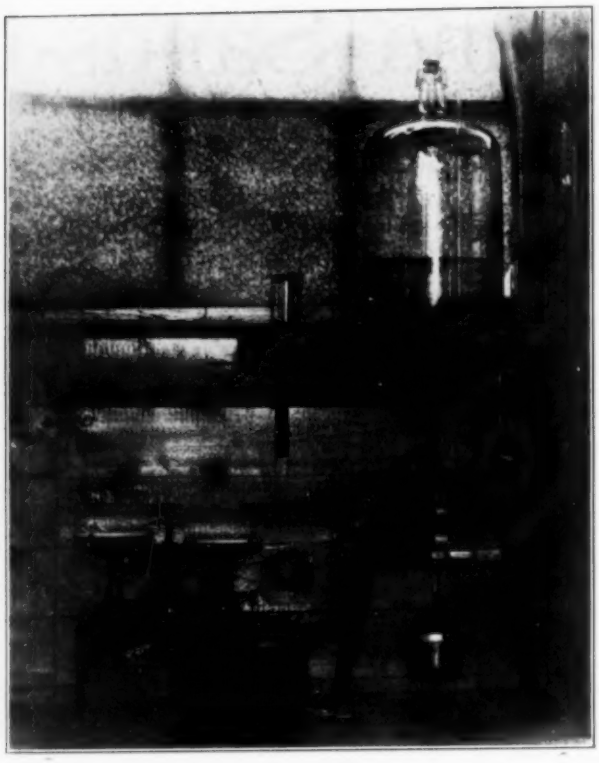


FIG. 4—A GALLOWS FOR VERTICAL TENSILE TESTS

box, the core supported by the sides of the box was transferred to a glass plate, and the sides removed after the core was placed. The core was then slowly and steadily moved endwise across the plate until the weight of the overhanging section caused the bar to break, and the length of this broken section taken to secure a figure indicating the strength of the sample. The data obtained by repeating this operation three times on each of four bars from the same sample are shown in Table I.

In each case the fractures were so irregular that it was possible to get different values of length, depending upon the part of the fractured section measured. The next step then was to weigh the overhanging section rather than to measure it. In this case, regardless of the result obtained, it was certain that the result was a true value and not merely a well directed guess. Table II shows some of the results obtained by weighing the overhanging section in the tests described.

We realized that the results obtained by the preceding methods, though they show a variation, might be sufficiently accurate to indicate the strength. However, they would be of value only for comparative purposes since they are but abstract numbers. To obtain a concrete stress value by these methods would necessitate the use of lengthy computations involving use of the length of overhanging section. Although comparative figures might prove sufficient for present purposes, concrete values would be of far greater service.

To obtain concrete values it was decided to try the tensile test in which the strength of the sand could be determined directly in grams per square inch. We felt that a green-sand core, with cross-sectional area of 1 square inch, would be too delicate to handle in any of the common methods for obtaining tensile strength. For this reason our first efforts to investigate tensile strength of sands resulted in the designing and building of the horizontal tensile test table, and a core with enlarged shoulders to receive aluminum clamps, shown in Fig. 2.

After ramming, the core suspended between the sides of the box was placed on the glass top of the table. The sides were removed and the aluminum clamps carefully adjusted. The load was applied by dropping sand into the container which hangs below the sheave shown at one end of the table. In this method many new difficulties were encountered, one of the most important being the friction between the core and the plate. Because of this friction, the pull was not distributed to all sections of the core, but was concentrated upon the point of application; hence all the cores broke at the shoulder. Results found by this method were variable, as can be seen by referring to Table III.

In this table the value shown in grams is the load per square inch under which each bar broke. Since this experiment was conducted to demonstrate the reliability of a method, the work was carried out as follows:

A quantity of facing sand sufficient for the test was placed in a humidor to maintain the same moisture content throughout the work. Five bars were made and then broken. These bars gave the results shown in the column marked Group 1. In the same way five bars were made and broken in groups 2, 3, 4, 5, and 6, so that a total of 30 bars were made from the same sand, under the same conditions, and broken.

To determine the maximum percentage of deviation of each bar, the difference between the average for that bar and its most divergent result is divided by the average value. The

Weight Broken Off in Overhanging Test

Table II

Bar	1	2	3	4	5	6
	Weight Broken Off—Grams					
Break 1	67.9	58.0	66.5	60.0	67.1	61.8
Break 2	60.0	61.2	58.6	72.1	61.2	65.2
Break 3	67.2	61.2	56.0	63.0	61.7	65.2
Break 4	62.0	59.0	57.5	60.6	58.0	65.2
Break 5	60.0	62.1	61.7	61.0	58.0	61.7
Average	63.4	60.3	60.0	63.3	61.2	63.8
	Maximum Deviation—Per Cent					
	7.1	3.8	10.8	13.9	5.2	3.3

Average maximum deviation—7.35 per cent.
Grand average break—62.03 grams.
Maximum deviation—16.1 per cent.

Table IV

Lubricant	No. 1 sand Grams	No. 2 sand Grams	No. 3 sand Grams
None	110	125	122
Oil	105	93	101
Silica sand	94	76	99
Paper	67	73	60

Table III

Results of Tensile Tests

Group	1	2	3	4	5	6
	Breaking Load—Grams per Square Inch					
Bar 1	198.0	193.0	223.0	256.0	221.0	202.0
Bar 2	208.0	220.0	210.0	220.0	208.0	294.0
Bar 3	200.0	173.0	210.0	262.0	200.0	288.0
Bar 4	181.0	187.0	243.0	249.0	176.0	290.0
Bar 5	226.0	187.0	258.0	296.0	300.0	205.0
Average	202.6	192.0	228.8	256.6	221.0	255.8
	Maximum Deviation—Per Cent					
	10.7	14.6	11.9	15.6	35.7	21.1

Average maximum deviation—16.76 per cent.
Grand average break—226.1 grams per square inch.
Maximum deviation—32.7 per cent.

PUBLIC LIBRARY
DETROIT MICH.

average maximum deviation is a numerical average of the maximum deviations of the individual bars.

The absolute maximum deviation for the entire table is calculated as for each bar, except that the average of all the values is employed.

Since all of the cores broke at the shoulder, it was decided to shorten the core and also to try to decrease the effect of friction by the use of parting materials. In shortening the core we constructed a box having the dimensions of a standard cement briquet. This core was rammed by top compression of ¾-inch and is shown together with its corebox in Fig. 3.

Silica sand, oil and strips of waxed paper were used as parting materials, giving the frictional value shown in Table IV.

Since strips of paper gave the best results, they were used in tests whose values are given in Table V. We realized that the load necessary to break the bar might be affected were it necessary to tear the paper. For this reason we placed two strips of paper, separated about ¼-inch, under the bar. The space between the strips was at the center of the bar where the rupture would take place.

A study of this table and a comparison with Table III will show you that though we had reduced friction to a minimum, we had accomplished nothing else. In each table it may be noted that the average load causing rupture of 30 bars was practically the same, being 226.1 grams per square inch in Table III, and 224.6 grams per square inch in Table V.

You will also note that with the decrease in friction, there was an increase in the average maximum deviation from 16.76 to 24.5 per cent.

During the experiments which were conducted in connection with this table, we found that we had an element to contend with other than the friction of the core on the table top. No matter how careful one may be in handling sand, it is impossible to keep all of it out of important working parts, such as the bearing of the sheave over which the load was applied, and we found in some cases where the test bar showed a higher tensile strength that the load necessary to break the bar was increased by the friction of the cord over the sheave when the sheave was prevented from turning by sand. Various means of eliminating this uncertainty were devised, but in the end we realized we would have to abandon a horizontal tensile test, because the possibility of error creeping into our

Table VI

Tensil Test—Load Applied Vertically

Group	1	2	3	4	5	6
	Breaking Load—Grams per Square Inch					
Briquette 1	335.0	320.0	435.0	310.0	346.0	271.0
Briquette 2	285.0	305.0	304.0	420.0	371.0	297.0
Briquette 3	305.0	363.0	425.0	300.0	301.0	360.0
Briquette 4	320.0	272.0	303.0	280.0	440.0	300.0
Briquette 5	362.0	406.0	360.0	320.0	284.0	330.0
Average	321.4	331.2	365.4	326.0	348.4	311.6
	Maximum Deviation—Per Cent					
	12.6	20.8	16.7	28.8	26.4	15.6

Average maximum deviation—20.15 per cent.
Grand average break—334.0 grams per square inch.
Maximum deviation—30.2 per cent.

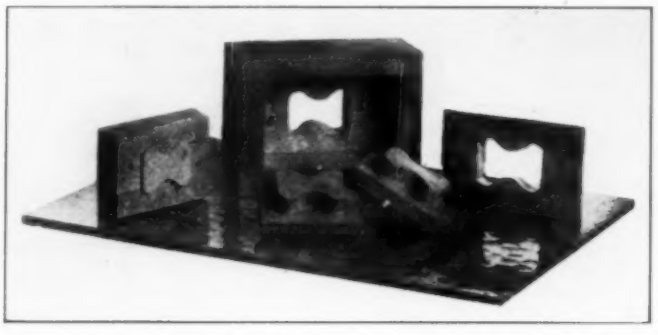


FIG. 5—COREBOX PERMITTING TOP AND BOTTOM RAMMING

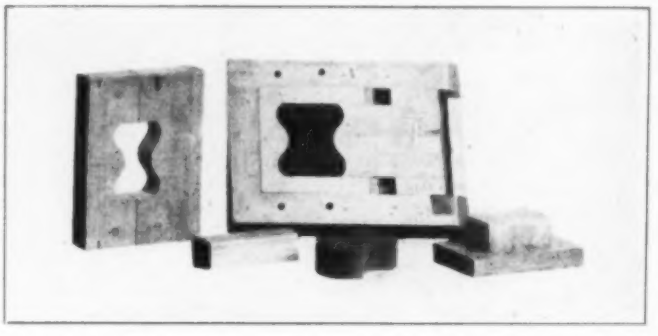


FIG. 6—COREBOX IN WHICH NECK OF CORE IS MADE LARGER THAN IN BOXES PREVIOUSLY SHOWN

Table V

Results of Tensile Tests with Shortened Bar

Group	1	2	3	4	5	6
	Breaking Load—Grams per Square Inch					
Briquette 1	248.0	173.0	221.0	208.0	200.0	181.0
Briquette 2	226.0	187.0	193.0	220.0	173.0	187.0
Briquette 3	223.0	210.0	210.0	243.0	258.0	256.0
Briquette 4	220.0	262.0	249.0	296.0	221.0	208.0
Briquette 5	200.0	176.0	300.0	202.0	294.0	288.0
Average	223.4	201.6	234.6	233.8	230.2	224.0
	Maximum Deviation—Per Cent					
	11.0	25.0	27.9	26.7	27.8	28.6

Average maximum deviation—24.5 per cent.
Grand average break—224.6 grams per square inch.
Maximum deviation—33.6 per cent.

Table VII

Tensile Test with Reduced Test Bar

Group	1	2	3	4	5	6
	Breaking Load—Grams per Square Inch					
Briquette 1	382.0	403.0	433.0	370.0	412.0	390.0
Briquette 2	312.0	342.0	282.0	300.0	302.0	280.0
Briquette 3	358.0	390.0	398.0	430.0	378.0	450.0
Briquette 4	352.0	360.0	312.0	365.0	332.0	385.0
Briquette 5	317.0	363.0	350.0	371.0	330.0	351.0
Average	344.2	371.6	355.0	367.2	350.8	371.2
	Maximum Deviation—Per Cent					
	10.75	8.5	24.8	18.5	17.7	24.5

Average maximum deviation—17.46 per cent.
Grand average break—360 grams per square inch.
Maximum deviation—25 per cent.

PUBLIC LIBRARY
DETROIT MICH.

determination through some cause, such as the one just referred to, was too great.

The next step was to design a gallows, allowing the force to be applied vertically, as shown in Fig. 4.

We found it was necessary to make the core strong enough to uphold not only its own weight, but the weight of the clamp and container as well, hence the amount of compression of the box shown in Fig. 3 was increased from ¼ to ⅞-inch. The load was applied by pouring silica sand into the container. With this method the results were still unduly variable as may be seen from Table VI.

We believed that the factors having the greatest effect upon the results were: first, time of suspension; second, rate of increase in load; third, uniformity of ramming core; fourth, strains set up in core during manipulations. Therefore, to eliminate the first two factors, the apparatus was modified so that a slow stream of water under constant pressure was used in place of silica sand. The pinch cock, just under the shelf, when opened allowed water to siphon from the bottle through a small glass orifice, shaped like a medicine dropper, in the lower end of the black rubber tube which shows just above the bucket in Fig. 4.

The third, and most important factor, was one that required a great deal of study and attention. Every foundryman knows that when sand is rammed, that portion of the sand which is farthest away from the rammed surface, is least dense, consequently the cores varied from a great density at the top surface to a lesser density at the bottom. For this reason we determined to construct a box which would permit of top and bottom ramming so that our core might be rammed by equal pressure, or by an equal amount, from two sides. Then, since the rammed surfaces would be more dense than the center of the core, we determined to shave off both rammed surfaces. A new box designed to permit these manipulations was constructed, as shown in Fig. 5.

By using this box we were enabled to produce a briquet 1.6 inches high by compressing from top and bottom a similarly shaped volume of sand 3 inches high. This briquet is shown at the left of the illustration and is held in place by the loose pieces 1 inch thick. It may be noted that the briquet projects beyond the wooden side. It does, in fact, project 0.3 inch on each side. Thus by holding the loose pieces tightly, we were able to strike off 0.3 inch from the top and bottom of the original volume, leaving a briquet 1 x 1 inch from the heart of the original volume, and rammed uniformly from top to bottom.

Cores made by this method were tested, and the results found on six groups of five each are shown in Table VII.

It may be seen that the results shown by this table are more uniform, but we were convinced after several repetitions of this experiment that results would not check one another close enough to be of practical value.

Table VIII

Core Made in Box with Two-Inch Opening

Group	1	2	3	4	5	6
	Transverse Tests Sample 2 Inches Wide					
Briquette 1	454.0	460.0	490.0	415.0	473.0	439.0
Briquette 2	414.0	424.0	400.0	421.0	422.0	438.0
Briquette 3	465.0	484.0	441.0	491.0	440.0	465.0
Briquette 4	474.0	463.0	453.0	440.0	455.0	480.0
Briquette 5	490.0	470.0	550.0	450.0	500.0	447.0
Average	459.4	460.2	466.8	443.4	458.0	453.8
	Maximum Deviation—Per Cent					
	7.80	7.85	17.80	10.60	9.20	5.95

Average maximum deviation—10.20 per cent.
Grand average break—456.9 grams per square inch.
Maximum deviation—20.40 per cent.

Table IX

Transverse Test—Sample Two Inches Wide

Bar	1	2	3	4	5	6
	Breaking Load—Grams					
Break 1	70.0	80.7	61.3	62.4	67.3	66.1
Break 2	63.5	70.2	58.1	52.9	68.1	68.3
Break 3	61.7	63.5	53.1	61.3	60.0	67.3
Break 4	64.0	64.0	60.7	58.1	65.9	60.0
Break 5	63.9	63.9	62.9	62.9	60.0	60.0
Average	64.62	68.46	59.22	59.52	64.26	64.34
	Maximum Deviation—Per Cent					
	8.35	18.0	10.3	11.1	6.3	6.7

Average maximum deviation—10.11 per cent.
Grand average break—63.40 grams.
Maximum deviation—27.5 per cent.

Variations Permitted

All of the core boxes thus far used had a neck which was but 1 inch across, and it was thought probable that in filling this narrow neck some bridging of the sand occurred. Such bridging would affect the volume of loose sand entering the box, increasing it in some cases and decreasing it in others, thus affecting the density of the ramming. To eliminate this possibility as far as possible, a box was constructed which had a minimum opening of 2 inches during filling. This opening was later reduced to 1 inch by side compression of the sand, and a final top compression completed the core. Fig. 6 shows the construction of this box.

From this box 30 briquets were made in six groups of five each and tested. The results are shown in Table VIII. These results are more uniform than any of those obtained so far by us in endeavoring to develop a tensile test which would give the green-bonded strength of a sand in grams per square inch.

A study of the results obtained thus far taken in conjunction with the theoretical considerations involved show that the horizontal tensile and the first of the vertical tensile methods have been eliminated as unreliable. Furthermore, the results obtained in the vertical tests by the best ramming methods we could devise only approximately equalled the results obtained with a crude corebox in the transverse test. Also, since the transverse test would decrease the possibility of straining the core in manipulation and thus be better suited for the weaker sands, it was deemed advisable to abandon the tensile and devote our energy to refining transverse method.

Having learned by our investigation of the tensile test that a wide box gave more uniform results than a narrow box, our first step in refining the transverse test was to increase the size of the core from 10 x 1 x 1 inch to 12 x 2 x 1 inch. In addition, the greater width of the core should decrease the effect of imperfections such as small pebbles, since the area occupied by such a flaw would be a smaller percentage of the cross sectional area of the core.

(*Concluded on Page 26*)

Methods of Molding Bushings

Brass Bushings of Various Shapes Require Different Treatment—Many Ways of Gating—Core Must Have Sufficient Prints and Be Placed so as Not To Crush the Mold when Closed

BY CHARLES VICKERS

BUSHINGS are simply hollow cylinders of brass of varying length and diameter. While they are sometimes made from solid cylinders of metal by boring out the center, they are more generally cast a tubular shape by the use of a sand core. Some bushings are comparatively long and narrow, others short and wide with a metal thickness varying from fractions of an inch to several inches. Large bushings, long, heavy and comparatively small in diameter are frequently designed as *sleeves*, and when a diameter of from 12 inches to several feet is combined with a body length of about the same dimensions they are known as *liners*, and in cases where the body length is shortened greatly in proportion to the diameter they become *rings*. As might be expected several different ways of molding such castings have been devised. They may be made horizontally, as shown at *G*, Fig. 1, or vertically, as at *A*, Fig. 1, and again with the horizontal method the flask may be poured while level, or it may be inclined to any degree. The gates that convey the metal into the mold also may be varied in location, shape and size. Sometimes, they are placed at the end of the bushing as at *A*, Fig. 2, and are connected into the end of the bushing. Or they may be located at the end and be connected into the side as at *B*, Fig. 2. The gate at *B* has to be cut oval in cross section, and should be made half in the cope and half in the drag. It also should be filleted where it joins the casting, otherwise it may tear a piece out if broken off while the metal is hot. The gate *A* Fig. 2, parallels the core print of the bushing and is carried in a straight line with the thickness of the bushing for about half an inch as shown, and the sprue is located midway between the two castings. This is done to enable the sprue to be broken off while the casting is hot without danger of *breaking in* as it is called, thus saving the expense of sawing off the gates. The breaking off is done by hitting the sprue near its top with a hammer, either towards or away from the castings, and it is important that the direction of the blows be in a straight line with the length of the castings. When this is carried out the gate will break away at the angle *C*, Fig. 2, leaving a small stub on the casting to be ground off. Gates are sometimes located midway of a bushing as at *G*, Fig. 1, and sometimes they are carried under the coreprint as at *A*, Fig. 4. This latter type of gate is used for castings of aluminum bronze, also of manganese bronze, as it carries the liquid metal gently to the lowest part of the mold and there is less dross-producing agitation as a consequence.

Gate Cut in Top

In vertically-poured bushings the gate may be cut into the top of the mold as at *D*, Fig. 1; into the bottom as at *E*, Fig. 1, or into any portion of its length as at *F*, Fig. 1. Sometimes the gate is located on top of the mold and consists of a U-shaped ring in a runner box with small-sized perforations in its bottom which lead straight down into the thickness of the molded bushing. Then the metal *rains down* and fills up the mold. In the case of the large, wide bushings known as cylinder liners, either top or bottom pouring may be favored, but when they are bottom-poured, it is important that more than one entrance be made for the metal into the mold to avoid porosity showing after the bushing is turned off. It is also necessary that the molten metal lies quietly against both mold and core for the castings to be sound after being machined. Whatever method of gating is used, there should be some legitimate reason for its adoption. Thus the gates in Fig. 2, while giving good results in the case of the plain, straight cylinders shown, might be the source of large production losses if used on a bushing of the shape shown at *I*, Fig. 1, because they would fail to properly feed the heavy section midway of the casting. In a case of this kind, the gate at the center of the bushing will give better results, or the mold can be made as in Fig. 4 which shows the mold for another type of bushing and illustrates the method of gating and risering it to produce good castings. This latter bushing is frequently called a sleeve and is a type of bearing used on electrical machines. The ball-shaped enlargement at the center claims attention as it must be fed by a suitable riser to avoid shrinkage which would give a flattened ball in the cope part. A riser 3 inches in diameter is used, connected to the ball at the joint of the mold by an oval-shaped gate about 1½ inches wide, by 2¼ inches high, and filleted at the point connected to the ball. The top of the riser is brushed to 6 inches above the top of the cope, to put pressure on the ball. The mold is poured as shown, the gate being connected underneath the core. After the mold is filled to the top of the sprue, the latter is covered with molding sand on which a weight is placed, and then the riser is slowly filled to the top of the bushing. By this method there is less strain on the mold than there would be if both riser and sprue were of the same height, and the riser was forced up through the sprue.

Sleeves of the shape shown in Fig. 4 vary in size so greatly that some are made several in a flask on the bench, while others are a floor job. The illustration shows one of the larger sizes. The method of gating under the core was found by experience to produce better results than a gate on the mold joint, either as shown at *A*, or *B*, Fig. 2. When a gate like *B*, Fig. 2, was used, the liquid metal entering the mold impinged on the core, and as the molds were poured strongly, the bronze caromed back from the core surface upon the mold, producing a cutting action on the green sand surrounding the gate which would scald off a layer of sand leaving a scab at this point, the loose sand washing as dirt elsewhere, usually to the top of the sleeve.

The gate *D*, Fig. 1, at the top of a bushing, is satisfactory for short, vertically-molded bushings, and should be used whenever it is found to produce good results because of its economy. It will be evident that it will cost more to mold a bushing when the gate has to be placed at the lower end, as at *E*, Fig. 1, because the mold must either be made three-parted, or runner cores of dry sand must be built in as the mold is rammed. The gate located as at *F*, Fig. 1, has no

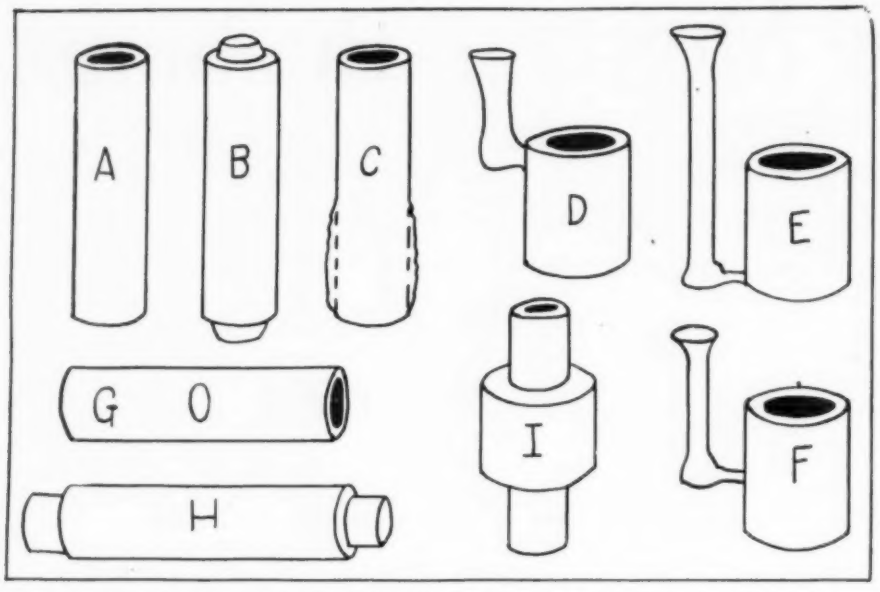


FIG. 1—SHAPES OF BRASS BUSHINGS SHOWING METHODS OF GATING

especial advantage in the case of a straight bushing, but for a bushing of the shape shown at *I*, Fig. 1, it has the advantage of shortening the fall of the metal, and brings the gate to the thickest part of the casting. A bushing of the shape shown at *I*, Fig. 1, molded vertically, would have to be cheeked off, to make a joint level with the top of the enlarged section, otherwise the pattern could not be removed from the mold, therefore, the molding cost would not be affected by carrying the gate down to this level.

Which Way To Mold

When castings are to be made of a long, narrow bushing pattern of the shape, shown at *H*, Fig. 1, the question may arise whether the horizontal or vertical method will be the better to use. Concerning this matter the patternmaker will probably have made the first decision, for, if the prints on the pattern are shaped as shown at *H*, Fig. 1, it has been intended for horizontal molding, if coned as at *B*, Fig. 1, for vertical molding. The decision as to the best method of molding a pattern should always rest with the foundryman, but as the patternmaker is expected to put on prints of some shape, and make a corebox to match, and as no matter what kind of print was put on, it probably would be wrong for the foundryman, it is always advisable to make the prints loose, and to ensure their replacement centrally by attaching to the print at its center, a short thick pin which will fit tightly into a hole in the center of each end of the pattern. It is then a simple matter for the patternmaker to make a change of prints to suit the foundryman.

Making molds for bushings with green-sand prints is a poor method of making such castings from a production standpoint, because it in effect makes a mountain out of a mole hill by introducing a number of variables requiring skill and experience on the part of the molder to control. The modern tendency is to simplify molding operations to the greatest extent possible, and thus enable comparatively unskilled workers to do the work in a satisfactory manner; in fact, because of a dearth of highly skilled workers it is imperative in many cases that this be done.

Sometimes the work of the green-sand molder can be lessened by the coremaker, and making bushings is an illustration of how this can be done to the benefit of all concerned. First, we will consider some of the difficulties encountered in making bushing castings by the green-sand-print method, so universally practiced. The illustration, Fig. 3, shows what frequently occurs when the cope is lifted off a mold containing a bushing pattern in one piece. There is a green-sand *lift* at the junction of the coreprint and the body of the bushing, which requires straight and careful lifting to get up perfectly. Even in the case of skilled molders it is not uncommon to have this ledge break down at one, or both end, as at *B*, Fig. 3, an accident that entails considerable loss of time in patching.

Rapping Through the Cope

It is usual to attempt to avoid bad lifts in the case of solid patterns, by rapping through the cope. A steel bar is inserted into a hole in the upper side of the bushing and is molded in with the cope. Previous to lifting off the cope the bar is rapped vigorously, then is withdrawn and the opening which is left is plugged with molding sand. This has the disadvantage of enlarging the casting if the enthusiasm of the molder is not tempered with moderation. Also, as the pattern seldom is molded with the same part of its circumference uppermost; it is not long before a ring of battered holes is formed around it. Then the rough spots left in the mold by the holes require considerable slicking, and slicking requires time. It is true all of these annoyances are avoided by using a split pattern, but this has its drawbacks too, for it has to be secured in the cope half so that it will lift with the latter, by passing wood screws with looped ends through the sand of

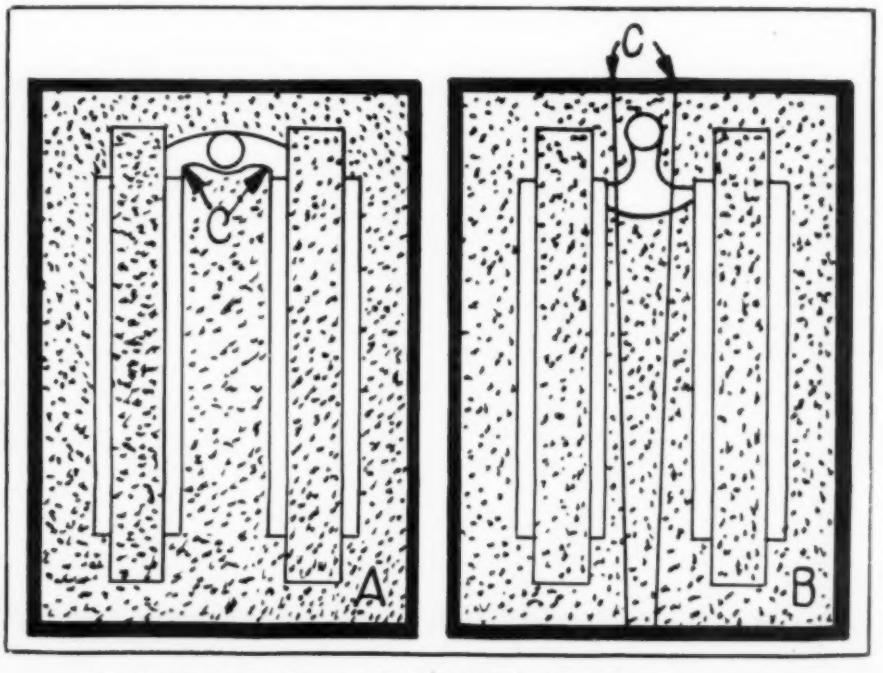


FIG. 2—METHODS OF GATING BUSHINGS CAST TWO IN A MOLD

the cope into the pattern. Then the wood screws have to be firmly anchored to the top of the cope by an elaborate system of bars and wedges; otherwise the half of the split pattern will stay down with a result exactly similiar to that of the pattern that is not split.

Only One Variable Eliminated

However, assuming it is not difficult to lift the split pattern, or that the patternmaker has so sloped the step in the solid pattern from the smaller diameter of the core that bad lifts rarely occur, this will only eliminate one variable. The core is a straight, round, cylindrical body of considerable weight, which has to be sustained by the two soft sand ledges at either end of the mold. If the ledges should be rammed too soft, the core will sink and crush its print. This also may happen if the prints are too short, even when rammed properly. It is a serious disaster to the mold, whether it is noticed before the latter is poured or not. This trouble will not be encountered as frequently as defects due to crushes in the cope, or as blowing due to metal flowing over the ends of the core prints into vents. Crushing of the print in the cope may be guarded against by *trying* on the cope, and usually before the try on a seal can be put around the end of the core prints so that the try on will reveal both the absence of a crush and certainty of the metal being blocked from running into the core vent. This seal is sometimes a thick flour paste smeared around the ends of the core, but a thick mud made with molding sand is far better. The latter is easily made and applied by scooping a small depression in the solid joint of the mold, filling it with water, then digging the mud on the slick and building a little ridge around the core-prints at the ends. The mold is finished except flouring, then the cope is closed and pressed down, then again lifted off carefully. The ridge of soft mudded sand should be flattened down by pressure of the cope; if it is not it should be built higher before the final closing. The vent in the sprue end of the core is frequently plugged by firmly ramming in molding sand. When flour paste is used as a seal it should be applied after the try on, as using it before is hazardous because it may stick and pull down sand from the cope.

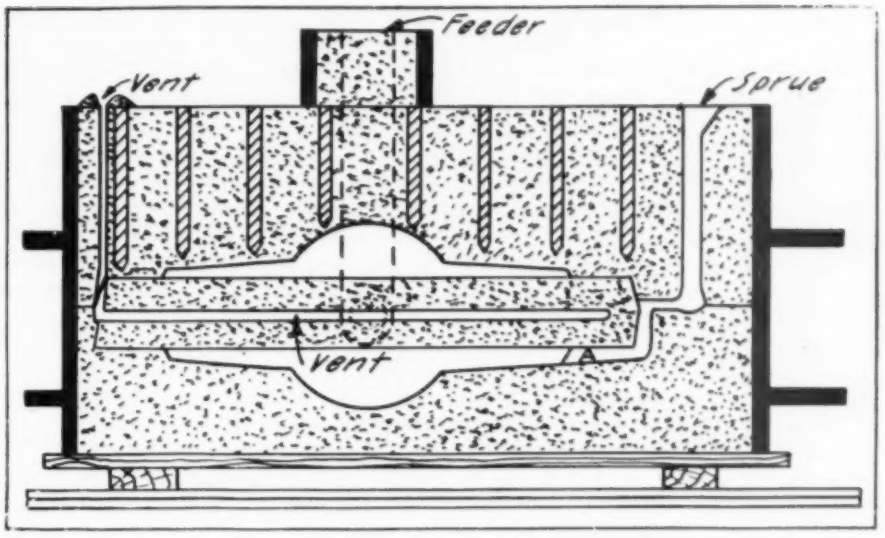


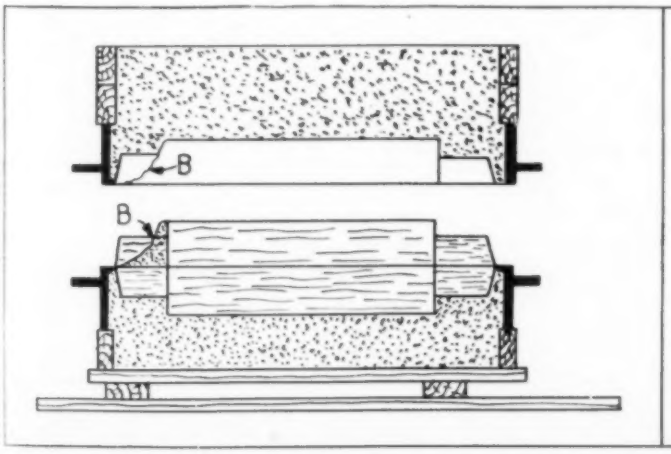
FIG. 4—LONGITUDINAL SECTION OF A MOLD FOR A MOTOR BEARING SLEEVE

Thus to mold a bushing having prints as at *H*, Fig. 1, requires no mean degree of skill on the part of the molder, for aside from the importance of a proper choice of the grade of molding sand, and a knowledge of the correct degree of hardness when ramming the mold, careful manipulation is necessary in lifting off the cope to avoid the disagreeable task of patching broken core prints. The core must have sufficient bearing not to crush the mold by its weight when being set. When finally closing the mold, should the try on be dispensed with, and the core not be entirely round, a crush of the prints may occur in the cope. Besides, the metal is apt to over-run the core prints and stop up the vent of the core. All of these accidents, any of which will cause a spoiled casting, must be guarded against by the forethought of the molder. Therefore, if there is any better way of making bushing patterns, a way that will eliminate all the difficulties mentioned, it should be generally known and used.

Simplifies Molding

Fig. 5 shows what is believed to be a much better way of molding bushings. The method is not new, having been known for many years, and practiced by progressive foundrymen. However, it is not used as much as it deserves; in fact, no bushing patterns of any kind should ever be made according to the old methods, with cores resting on soft green-sand ledges or prints, and as fast as all old patterns of the green-sand-print type have to be replaced, the new method should be adopted.

In Fig. 5, the pattern is shown at



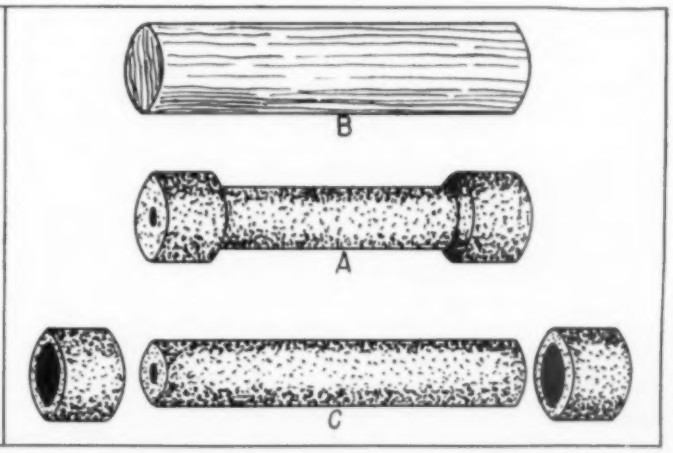


FIG. 3—SAND FROM THE COPE IS LEFT ON THE PATTERN AS SHOWN AT *B* WHEN THE LIFT IS NOT CORRECTLY MADE
FIG. 5—SELF-CENTERING BUSHING CORES, WITH PATTERN SHOWN AT *B*

B, and it is simply a straight cylinder, the core is shown at *A*. This figure illustrates how the core is centered and retained, and shows what a simple matter it is to make bushings by this common sense method. The ends of the bushing pattern *B*, should be coned sufficiently to provide against any tearing of the sand when lifting off the cope or drawing the pattern. The core if in one piece as at *A*, Fig. 5, can be made to fit accordingly. If a small groove is scored on the pattern at the limit of the coreprint stop offs, it will serve as a guide in locating the gate when the latter is of the type shown at B, Fig. 2.

Should the method at *A*, Fig. 2, be preferred the gate will have to be filed in the core, or it may be molded in by setting a piece of wood in the corebox. With a pattern and core of the type shown in Fig. 5, after the mold is made and cleaned, all that is necessary is to drop in the core and it is finished, provided the core fits properly into place.

If the core does not fit it may be necessary to use paste on the prints to make a seal against the flow of the metal into the vents. That is the only precaution to be taken, no trying on is necessary and there need be no anxiety about crushing of the prints.

Cores Machine Made

As far as the work of the coremaker is concerned, it is not increased by the dumbell ends of the core when the latter is made by hand. When the straight core is made by a core machine, the prints have to be made in a separate box which is simply a ring core, easily and quickly made in quantity. The rings are threaded onto the long core and may be cemented in place, as this work will save the molder the necessity of sealing the print onto the core to prevent the metal seeping along into the vent. This method works well when the same pattern must be used for a shorter bushing, as the coremaker simply uses a shorter central core, and the molder merely stops off the cavity in the drag left behind the shortened core to ensure its remaining in place in the mold. To *cut off* a horizontally-molded bushing having green sand cores is an artistic and time-consuming job, which it will be unnecessary to describe thanks to the method using a dry-sand core print, as just outlined, for even though it is one of the choice tricks of the molders trade, there will be nothing especially valuable lost, if it be entirely forgotten.

How and Why in Brass Founding

By Charles Vickers

Miscellaneous Scrap Does Not Equal Ingots

We are asked to make some brass and bronze castings, and as the latter are merely casing and miscellaneous castings which require a certain amount of strength, it is our belief that an alloy of copper, 85 per cent; tin, 5 per cent; zinc, 5 per cent, and lead, 5 per cent would suffice. We want to be in a position to use other alloys if required, and will appreciate any formulas you may be able to give us. We like to use about 70 per cent new metal and 20 per cent scrap, and desire formulas for scrap mixtures.

It is impossible to present a mixture using part scrap, unless by scrap is meant scrap copper, if the composition of the scrap is not known. Even if scrap copper is used it is difficult to understand just what economy would be effected, as compared with the use of ingot 85-5-5-5. A recent quotation for ingot 85-5-5-5, in your vicinity was 11.50 to 12.00 cents per pound. The cost of 85-5-5-5, using all new metals at the price on that date was a little over 14 cents per pound. The same mixture made from heavy scrap copper and wire under the same quotations, would cost 11.57 cents per pound. The latter price does not cover shrinkage of metal incidental to using scrap copper. Therefore, ingot at 12 cents per pound, all metal, ready mixed, and in the best possible shape to melt, is considerably cheaper than metal in any other form. A properly handled furnace should melt at least four heats of the ingot metal to three heats of scrap metal.

When scrap brass, heavy or light, is used as part of the charge of any alloy of known composition, and the scrap brass is used directly instead of first being run into ingots and analyzed, the result is a mixture of unknown composition, which may be totally unfitted for the purpose for which the castings are to be used. Danger exists through contamination by aluminum, iron, and possibly antimony, dangerous impurities that are removed by the producers of reliable ingot metals. When scrap copper is used the loss in melting will vary with the quality of the scrap. Heavy copper, and crucible copper will show the least loss. Where the cheaper grades of copper are used and 85 pounds are charged, the mixture will not measure up to expectations, because there will not be 85 pounds of copper in the crucible when it is melted.

When the composition of the scrap is known, machinery scrap can be melted with yellow brass scrap to secure the required tin and zinc content of the alloy, and leaded alloys may be used as a source of the lead content. The use of highly leaded alloys is not advised, because they frequently contain a comparatively large amount of sulphur, added to *hold in the lead*.

The following is a strong alloy;

Strong Yellow Brass	Per cent
Copper	90.00
Tin	6.50
Zinc	2.00
Lead	1.50

As before remarked if scrap brass of unknown composition is added, even in the form of old valves and similar materials the alloy will not resemble the foregoing composition, and no one can predict what it will show until an analysis is made. Another good alloy is,

Strong Yellow Brass	Per cent
Copper	88.50
Tin	5.50
Zinc	3.50
Lead	2.50

Aluminum Cuts the Sand

Please advise what is the best material to use on sand to prevent aluminum from cutting the face of the mold.

Molds for aluminum castings usually are not dusted with any material to prevent the metal *cutting*. It is not necessary to use a facing of any sort except where a coarse grade of sand is employed. In that case a finer sand facing may be used on occasional aluminum castings.

However, when the aluminum actually cuts the molds it may be advisable to dust them with talc just before closing in the same manner as molds for brass, are dusted with flour.

Railings Are Dirty and Small Valves Leak

We are casting ornamental railings from ordinary brass and have experienced some trouble due to spotting, dross, blow-holes and contraction and will appreciate any suggestions you may offer that will assist us in overcoming this difficulty. We also cast gun metal valves, gage cocks and other boiler fittings and experience similiar difficulties and in addition the castings leak when tested to the extent that a considerable percenage must be re-cast.

We presume the spotting mentioned appears after the castings have been dipped in acids to bring out the color. This trouble is caused by little specks of dross into which the acids penetrate and lie hidden, later to emerge and produce a discolored area after the castings are finished. If the castings can be produced free of dross inclusions there will be no difficulty due to spotting out, but in any case the spots may be eliminated by heating the castings to a little over 212 degrees Fahr., after they are dipped, then immerse in lime water, dry again and polish. Dross is kept out of yellow brass castings by the method of pouring the molds. The metal must be skimmed clean, it must be hot enough to flare quite strongly and it must be poured in such a manner that the sprue heads are kept filled with metal all the time of pouring. Some brass unavoidably will be spilled on the castings shop floor. The heads fill suddenly and overflow, but this cannot be avoided. If this method is adopted, the zinc oxide will be kept floating on top of the sprue and cannot get into the mold. The metal smokes to some extent within the mold and therefore little vents must be scratched from all around the castings to the flask joint and especially from all sharp corners where the gas may get pocketed and thus hold back the advancing metal. The gates on yellow brass scroll work must not be cut into the edge of the castings, that is the thickness. They must be cut into the back or cope when the casting is molded scrolled face down and leave little lumps on the casting to be ground.

When no aluminum is used in the brass, the zinc content should not be higher than 26 per cent. With about 2 per cent tin and 2 per cent lead this alloy will make nice clean castings. The addition of 2 ounces aluminum per 100 pounds of yellow brass permits the use of as high as 40 per cent zinc, and the castings will be clean and bright. For railing angles and tees and other brass work of that character use a brass with about 26 per cent zinc, as outlined. Provide strong, well-vented cores with heavy balancing prints to prevent their cutting through and never use copper nails as chaplets to hold such cores. Be careful the metal does not get into the vents of the cores and place a high cope on the molds and pour strongly to keep the heads filled. About 2 ounces of manganese copper per 100 pounds of brass will greatly assist in getting smooth and perfect castings. The contraction is due to either too low a cope part, or to too small a sprue which does not properly compensate for the shrinkage of the metal. Keep all traces of aluminum strictly out of the gun metal otherwise the castings will leak; pour the molds with hot metal, and pour strongly. Just before pouring add a little phosphor copper, not more than 1½ ounces per 100 pounds of metal. In melting both brass and gun metal, if crucibles are used, keep the surface of the metal well covered wtih charcoal all the time.

Facings Aid in Cleaning Brass Castings

We make bronze castings wighing from 1000 *to* 5000 *pounds and have difficulty in removing the cores. The metal which has a composition of* 75 *per cent copper,* 10 *per cent tin,* 15 *per cent lead must be poured hot to obtain good castings, but when the metal is poured hot it eats into the cores and much time is required to clean the castings. Can you perhaps recommend a good core wash, that would prevent the metal getting into the cores?*

We have seen some clean castings of the weights mentioned made in the same alloy when the cores and mold were coated with a good grade of plumbago facing. Any supply house will be glad to suggest a suitable grade of plumbago. Bear in mind that cost is a secondary consideration, as a little more per pound will be saved many times over by getting clean castings. The tendency of some foundrymen is to buy as cheaply as possible, when it comes to these facings and washes. Therefore, if plumbago wash has been used so far the trouble is due to its not being suited to the cores on which it was used.

It may be advisable to paint on several coats of the facing, and in the case of cores of thin section surrounded by considerable thickness of metal, it is necessary to put on a finishing coat of plumbago applied as a paste with the fingers, and rubbed onto the core, until it is polished like a stove. If the above precautions have been taken and have proved a failure in this particular case, there is nothing else to be done except to try a coating of alundum cement applied to the cores. This material should be mixed with water to a cream and be painted on, followed by drying.

Impurities Found in Scrap Valve Castings

We are making castings of an alloy of 85 per cent copper, 5 per cent tin, 5 per cent zinc, and 5 per cent lead, using miscellaneous scrap steam castings, such as valves, injectors, etc., as part of the mixture. We find by analysis that these castings contain approximately 0.30 per cent aluminum and 0.30 per cent magnesium and when used in our heats produce castings with an open-grained fracture, which fail to withstand steam pressures. Will you inform us how it is possible to avoid the bad effects of scrap of this composition?

We are surprised to learn of the aluminum and magnesium content of old valves and injectors made by reliable concerns as we have always believed that great care was taken to select metals free of the injurious elements mentioned when making such castings. We suggest the scrap be melted together and another analysis made, this time by an analyst whose results cannot be seriously questioned, as the difficulty may be due to some other cause.

Nothing can be done to offset the aluminum and magnesium and it will be necessary to discontinue the use of such material in making pressure goods. The loss due to defectives when using this scrap will be so high it would pay to use all new metals rather than a mixture containing the castings. However, an ingot metal of the composition named can be procured that will be entirely free of the objectional impurities, and the use of this will effect a saving.

Alloy to Use With Die Casting Machine

We would like to obtain the formula for an alloy strong and tough, that can be cast in die molds, one that may be nickeled or silver plated. What material is employed in the dies that handle such an alloy?

Aluminum bronze approximately 90 per cent copper, 10 per cent aluminum is the strongest and toughest alloy cast in die molds. A die casting machine of course has to be used to hold and manipulate the dies, withdraw cores, and render it possible to obtain a production of castings sufficient to make the process commercially feasible. Both steel and high nickel alloys are used for the dies.

If a low melting point alloy is desired, use genuine babbitt and the castings will possess a certain amount of toughness, more so than the harder white metals used in making die castings, and which have little or no elongation.

Permeability of Malleable High

Magnetic Properties Make It Suitable for Small Motor and Generator Frames—Castings Produced with Large Risers Which Serve To Feed the Metal as It Shrinks

BESIDES possessing the combined qualities of strength and ductility which, with its casting properties, have made it such a useful casting metal, malleable iron possesses high magnetic permeability and low hysteresis, especially at the lower densities. This magnetic quality makes it available for small motor frames in competition with steel, which, while of a higher permeability, is sometimes more expensive and usually machines less rapidly. Fig. 3 is a permeability curve of malleable iron, made by Edward Hughes, Dayton, and shows graphically the relation between the magnetizing force and the resultant magnetic inductance. The rapid rise of the induction at the lower densities of the magnetizing force is clearly indicated. But at the higher densities this slopes off much more rapidly than is the case with cast steel.

The Dayton Engineering Laboratories Co., Dayton, O., avails itself of the magnetic properties of this metal and employs it in the frames for generators and motors in its automobile starting and lighting systems. Fig. 2 shows the method of molding a side frame for the generator used on the Buick six-cylinder car as applied by the Dayton Malleable Iron Co. As may be noted from the pattern on the squeezer machine, two down gates are used for pouring the metal and a large feeding riser is supplied. This may be more clearly seen on the casting on the bench. The metal is poured down the gates through two strainer cores, *AA*, Fig. 2 and under these cores both streams part into two runners to the casting on each side of the strainer core. The drag mold below the cope indicates the size of the neck of the riser, at *B*. A dry-sand core is placed over the riser opening in each mold. This not only prevents dirt from falling

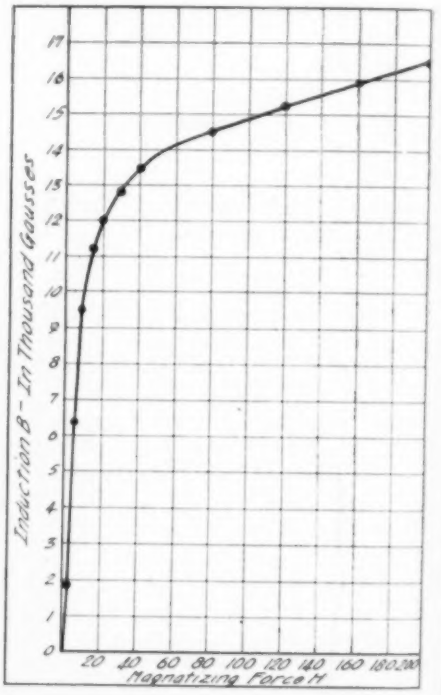


FIG. 1—ABOVE—MOTOR FRAME CASTINGS ARE POURED WITH A HORN GATE —FIG. 2—AT THE RIGHT—LARGE RISERS ARE PLACED ON GENERATOR FRAME CASTINGS FIG. 3—AT THE RIGHT ABOVE—PERMEABILITY CURVE OF MALLEABLE IRON

into the mold, but has been found helpful in eliminating blows in the mold, when poured.

The round motor frame castings are molded by a radically different method The molds are made on a jar-ramming machine and the castings are poured, two in a mold, from a separate horn gate to each. The horn gates are connected to a common down gate as indicated in the drag standing on the bench in Fig. 1. The sprue attached to one of the castings also may be noted in the same illustration. Large shrink balls are used to feed the castings as are shown both in the mold and in the pattern, Fig. 1. The casting has a 4¼-inch draw.

Recalls Castings Seen at Paris Show

BY ROBERT E. MASTERS

IT GAVE me much pleasure to read R. V. Ronceray's splendidly illustrated article in THE FOUNDRY recently describing making locomotive cylinders at the plant of John Cockerill, Seraing, Belgium. I have seen quite a good deal of work made by this company.

During the winter of 1888 and '89 a move was made through Congress to send an expedition of American mechanics, one from each of the principal trades, to the Paris Exposition, and through the leading countries of Europe, the object being to look into conditions there, to note how the mechanics did their work, what they got for it, and how they could live on it. These data were to be compared with information regarding the same class of mechanics in the United States.

The proposition was juggled around in the most delightful fashion, and given the most favorable consideration as an important subject, and means of obtaining reliable information, but nothing definite was done and no appropriation made to carry out the project.

A syndicate of newspapers stepped into the breach, told the trade associations to pick out their men and they would finance the trip, for the news, and an agreement was made on that basis.

Writer Is Selected

Among a number of candidates named from foundrymen, John A. Penton put forward the name of the writer. He maintained I had been giving knowledge and experience in foundry matters for several years through the technical press, and he wanted a representative who could describe and illustrate what he saw. Mr. Penton put his ideas across and I was selected to go.

That is how I came to see the output of the Cockerill Co. of Seraing, Belgium. Simply as a sample of their ability in foundry work, they had on exhibition a most wonderful casting. It was a triple expansion naval engine, with the cylinders, main body, condensers, air pump, circulating pump, bed plate with pillow blocks, all cast together forming one solid complete machine. This was on exhibition just as it came from the mold, with the fins on it. There was not a particle of sand or scab or a swell on it anywhere, nor could the mark of a hammer or chisel be found on the whole casting. The gentleman who was looking after the Cockerill company's interest, said to me, "As you readily see it has no practical use, only, to give the measure of what can be obtained at the foundries at Seraing."

Ingenuity Shown

Consider the thought, ingenuity, and mechanical skill it took to produce such a startling advertisement. One look at it and there was no question, even to a layman, of their ability as foundrymen.

The casting weighed 21,000 pounds, was 10 feet 4 inches high, 9 feet 10 inches long and the same wide; it will be noticed it was not a heavy casting when compared to its size, many of us have made much heavier castings in far less compass, but that was one of the beauties of this piece of work, so many light and heavy parts all through it and not a crack in it.

Another casting, on exhibition from Barrand Freres & Co. foundries, de St. Cybard, Angouleme, excited a great deal of admiration from visitors interested in the foundry business. This casting consisted of seven gears cast one above the other *on one hub*. Take them as they lay on the platform, one would have thought at first they were separate gears, of different kinds and sizes, placed on top of each other and resting on the hubs. The bottom one was a beveled mortised gear 26 inches in diameter, then followed in regular order, a plain beveled gear, a worm gear, a gear with V-shaped teeth, then a gear with the teeth running angling from right to left, in the next gear the teeth ran angling from left to right, and above this was a plain spur wheel 8 inches in diameter. The gears were about two inches apart and had from four to six arms in them. They gradually diminished in size from 26 inches to 8 inches, the hub was 4 inches in diameter, and had a 1¼-inch hole through it.

La Blanc, Georgi & Co. Foundries de Marquis, exhibited a bell mouth cast iron water pipe 52 inches inside diameter and 20 feet long, and a T-pipe connection 7 feet inside diameter. A quarter section cut from both of these showed the castings to be as perfectly even all through as if they had been turned in a lathe.

In one large brass foundry visited, they used a mixture of plumbago in the molding sand for a facing on molds for brass castings, and also in the core sand, then dusted and slicked china clay on the surface of the mold, and used a china clay wash on the surface of the core.

For bronze castings they used a mixture of plumbago in the surface and core sand and dusted plumbago on the mold and slicked it down and used a plumbago wash on the surface of the core instead of china clay.

Their product was heavy brass and bronze castings, the sand and cores rapped from the castings leaving them perfectly clear. The superintendent of this plant told me of another foundry making brass castings the other extreme to them, small castings of a character that would pay for a visit.

Made Thin Castings

I went there and saw that they had made and were making a number of brass plates 8 inches wide, 12 inches long, ⅛ of an inch thick, one side of which was covered with letters little larger than the type used to print this article. The letters stood in relief, clean cut and without a blur, and they were made in sand molds.

The foreman kindly consented to show how he preserved the letters intact, so they would withstand the wash of the metal. Of course, any foundryman will understand in work as delicate as this, no kind of sponge or camel's hair brush could be used to set the letters. Finely powdered rosin was shaken evenly and carefully over the surface of the mold and a

hot plate set over and close to the surface for a few minutes. This melted the rosin into the sand, and presented a hard, firm surface to stand the flow of the metal.

Before seeing this, and both before and since the day of compounds, I was always a strong advocate of the use of rosin in the foundry and was a buyer of this material in the New Orleans market by the carload. It was put to many uses and marked savings were made.

Foundry Equipment House Issues Bulletin

All about the cupola would be an appropriate title for a handsome bulletin of 47 pages 6 x 9 inches recently issued by the J. W. Paxson Co., Philadelphia. It contains information for any person interested either in the erection, operation or maintenance of the universal medium employed for melting gray iron. Details are presented on the area and depth of foundation required, method of erection and the proper relative position of the various openings in the shell. Attention is directed to the size and function of the tuyeres and their area in proportion to the horizontal area of the cupola at the melting zone. Tables are included showing dimension and capacity of cupolas from 28 to 108 inches diameter inside the shell; dimension and capacity of positive pressure blowers, capable of delivering from ¼ to 112 cubic feet of air per revolution. A second table indicates the number of tons melted per hour, revolutions per minute, horsepower required, diameter of cupola, diameter of blower outlet and a supplementary table gives the same information for centrifugal blowers used in connection with cupolas having a capacity of 1000 to 20,000 pounds per hour. Rules are given for finding the melting capacity of any cupola and also for estimating the approximate horsepower required to displace a given volume of air at a given pressure.

A sample sheet to be posted on the charging floor for the direction of the melter is shown on one of the pages. It contains data and information required to operate a cupola efficiently, including pointers on lighting, charging, fluxing, air blast, tuyeres, tapping and slagging. This is supplemented on the following page by detailed instruction on how to charge a 42-inch cupola.

Figures are presented to show the number of cubic feet of air required to consume one pound of coke, the number of pounds of iron melted per square inch of melting area, cubic feet of air required to melt one ton of iron, horsepower required per ton of iron per hour, horsepower per 1000 cubic feet of air and the space occupied in the cupola by one pound of coke.

Data on fire and red brick include dimension and weight singly and per cubic foot; space occupied when stacked and number required to lay 4, 9 and 13½-inch walls. Supplementary data show the number required and weight of a cubic foot of wall; average weight in bushels and cubic feet of coal, coke, charcoal, concrete, clay, gravel and sand. Another rule follows for estimating weight of piled pig iron. Several pages are devoted to description and care of lining material, cupola blocks, fluxing material and refractories in general. Three concluding pages cover in intimate detail actual operating practice. The bulletin also includes references to related equipment, blowers, scales, ladles, monorails and elevators, list of installations in the United States and foreign countries, sectional drawing and description of a modern foundry.

Manufacturers Seek to Improve Refractories

A movement has been started to secure information with regard to the furnace conditions which confront refractories in actual service. It takes the form of an industrial survey, which will be conducted by the Refractories Manufacturers' association in co-operation with committees which have already been appointed in associations of users of refractory brick, and with individuals, firms and corporations to whom refractory brick is an industrial necessity.

Information will be gathered by using a rather elaborate questionnaire; which will be distributed to consumers of refractory brick in the thirteen industries to which the bulk of this material goes. It covers temperature and combustion conditions found in the typical furnace, abrasion, slag action, the presence or absence of uncommon furnace gases, spalling conditions, loads, insulation, character of draft, etc. The answers to the questionnaires will be sent to the Mellon Institute of Industrial Research, at Pittsburgh. Reports will be made when enough informaion to warrant it has been received from any single industry.

Every consumer of refractory brick will derive a certain benefit from the successful prosecution of the work described. Wastes will be eliminated, which cannot help but reduce production costs. Intelligent service will follow authentic knowledge.

Use Duplex Process for Refining Steel

An interesting new steel making process has been put into operation at the works of Edgar Allen & Co. Ltd., Sheffield, England. A 10-ton and a 3½-ton Stobie electric steel melting furnace are being worked together as a single unit under the inventor's patent duplex electric process. By this means scrap steel is electrically melted and refined by oxidation in a continuous manner in the large primary furnace, and a third or more of the molten bath is transferred down a chute at short intervals to the small secondary furnace for the finishing process.

The advantages claimed for the process are both electrical and metallurgical.

Electrically, the load factor is said to be increased by the continuous working, and the power factor is improved by the maintenance of molten baths almost continuously. Also fluctuations of current are said to be less marked and of shorter duration.

The main metallurgical advantage claimed is the frequent supplies of small quantities of steel, of varying compositions, if required. Additional advantages of the new process over an installation of several furnaces working independently are said to include the less space occupied by the plant; the reduced crane service required; the lower cost for repairs to furnace linings for a given output of steel, and the freer choice in scrap for melting.

Plans Tests to Define Sands—I

(*Concluded from Page 18*)

To test this theory a box was built similar to that shown in Fig. 1, in all respects except width and length. Cores made in this box, therefore, were 2 inches wide instead of 1, but were rammed by top compression only.

These cores being twice as wide, were approximately twice as heavy, so it soon became apparent that some were strained and some actually broken while transferring them from the box to the glass plate. To overcome this difficulty the glass plate was made a part of the bottom of the corebox. This permitted us to remove the core from the box without injury. The results obtained by 30 breaks on six bars are shown in Table IX.

The North Milwaukee Foundry Co., North Milwaukee, Wis., a gray iron jobbing firm, has purchased the equipment of the Modern Steel Castings Co., Milwaukee, Wis., and will make steel castings by the converter process.

MICROSCOPY OF CAST IRON

(*Continued from Data Sheet No.* 458)

Ammonium persulfate (10 grams + 90 c.c. water) was found to attack both ferrite and pearlite, leaving steadite white. It affords a ready means of distinguishing small particles of ferrite from steadite dendrites at low magnifications.

After trying for some time to get an accurate idea of distribution of sulphur in gray iron by using sulphur prints, a method employing dilute phosphoric acid was devised. The polished face of the sample is covered with a thin layer of phosphoric acid (2 c.c. syrupy phosphoric acid + 98 c.c. water) and brought into focus (16 m.m. objective). Bubbles of hydrogen sulphide gas rise from the graphite flakes. There is no other action for a long time. Then the acid begins to attack the metal. The evolution of hydrogen sulphide proves the presence of sulphides in the graphite flakes.

Nitric acid etching solution generally consists of 5 to 10 c.c. concentrated nitric acid to 100 c.c. alcohol. Its general action is like that of picric acid, but it produces rather coarse etching.

Heat tinting was devised by Professor Stead. To heat tint, the polished sample is carefully dried and placed on a hot plate with the polished surface up. As the specimen gradually becomes heated the polished face will show varicolored oxidation. The various component oxides will show different colors according to the degree of oxidation. The results found in gray iron are shown in the table on Data Sheet No. 458. This method is advantageous for showing the network structure of graphite.

Relief polishing (used by Sorby, Osmond and others) consists in polishing a long time, using a soft backing and fine abrasive. The method is useful for

(*Continued on Data Sheet No.* 460)

MICROSCOPY OF CAST IRON

(*Continued from Data Sheet No.* 459)

showing the presence of hard components. These stand in relief. Steadite in gray iron is shown by this method.

Photomicrography—The essentials in successful photomicrography are: Properly prepared specimen; exact focus on the most representative sections; even lighting; correct exposure. Directions for setting up the microscope, stand, lamp, and camera accompany each instrument. True magnification is best determined by a regular stage micrometer. A table should be prepared showing the exact magnifications with various combinations of objectives, eyepieces, and bellows lengths. If measurement of bellows length is not convenient, magnifications may be determined using the size of the total circle thrown on the ground glass.

The sample is brought into approximate focus with the rack-and-pinion movement, then exact focus is obtained by means of the fine adjustment. The lowest magnification which shows details clearly should be used. A focusing glass is useful for focusing on fine structures at high magnifications. It must be remembered that any jar of the instrument or wabbling of the specimen will destroy the focus. Stopping down the light by means of an iris diaphram is a useful method of bringing more of the field into sharp focus, especially for overcoming slight relief polishing or etching.

Uneven lighting has caused trouble for many microscopists. Arcs will flicker, nullifying the most careful work in centering the light. To insure a steady arc avoid drafts, use small carbons and direct current, and see that the positive carbon is placed horizontally. Be certain that the image on the ground glass is evenly illuminated before placing the plate. Effects of little irregularities in exposure often can be overcome by juggling the lights in printing, and favoring the underexposed portion in developing the print.

(*Continued on Data Sheet No.* 461)

THE FOUNDRY DATA SHEET, JANUARY 1, 1923
Payment will be made for all contributions on foundry and pattern shop practice suitable for publication

Note—This sheet may be cut into two sections, 5 x 7 inches, and may be readily bound in note book form.

Compares Cupola Receivers

Use of Forehearths or Cupola Receivers Is Common Abroad—Separate, Self-Contained and Portable Types Are Compared—Superheating Possible in Some Cases

BY F. J. COOK

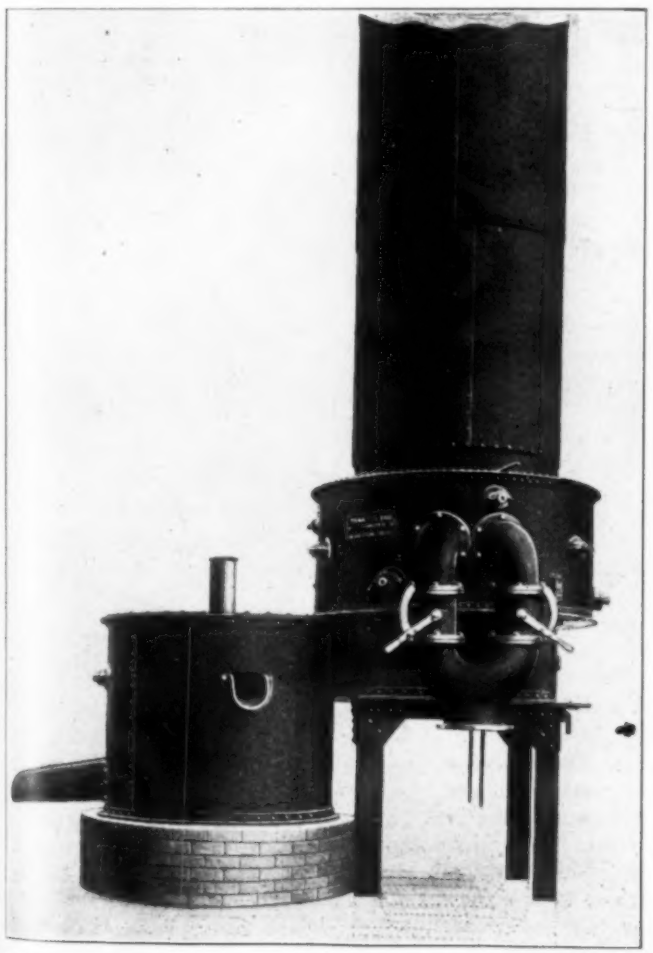
ANYONE wishing to study the question of cupola receivers will encounter a complete absence of data in any definite form in connection with this important adjunct to the cupola furnace. The proceedings of the Institution of British foundrymen from the commencement contain only one reference to the matter, and that in a casual way. Text books are equally devoid of definite information; Kirk in his book, which so admirably deals with the cupola, makes a bare mention of receivers. The only one that gives any details of the advantages and disadvantages is by Dr. Moldenke.

Makers of cupolas are not definite on the matter, rather leaving the individual to pay the money, and take his choice. Therefore it is opportune, and the Birmingham branch is to be commended for affording an opportunity to discuss the matter, which in conjunction with the discussion last year on cupolas should be of great use to the industry generally. As the time allotted is short, I have thought it desirable to deal with the various types of receivers, and salient points connected with each, leaving more technical matter concerning the influence on the metal owing to the action of the slag, etc., to be dealt with by Mr. Fletcher. Fig 1 shows the general arrangement of a cupola with outside receiver of the usual type, associated so long with Twaites Brothers, Ltd. Fig. 2 shows a general section of the same, and Fig. 3. is a more detailed section of the receiver and arrangement of vent.

The usual practice is to make the receivers of a capacity to hold about half to three quarters of the hourly rated output of the cupola. The advantages generally associated with this type of receiver are:

First. Reduction of consumption of coke, owing to the quantity required for the bed being eliminated. This amount will vary in accordance with the amount of bed space allowed in the cupola for storing the molten metal before tapping. Where the metal is drawn away as melted, as in the case of small light work, it is obvious that there is little economy in this direction to be obtained from a receiver, for the conditions of a receiver do not in any way reduce the consumption of coke necessary to *melt* the metal after the cupola is operating.

A paper presented at a meeting of the Birmingham branch of the Institution of British Foundrymen. The author, F. J. Cook, is director of Rudge-Littley, Ltd., West Bromwich, England.



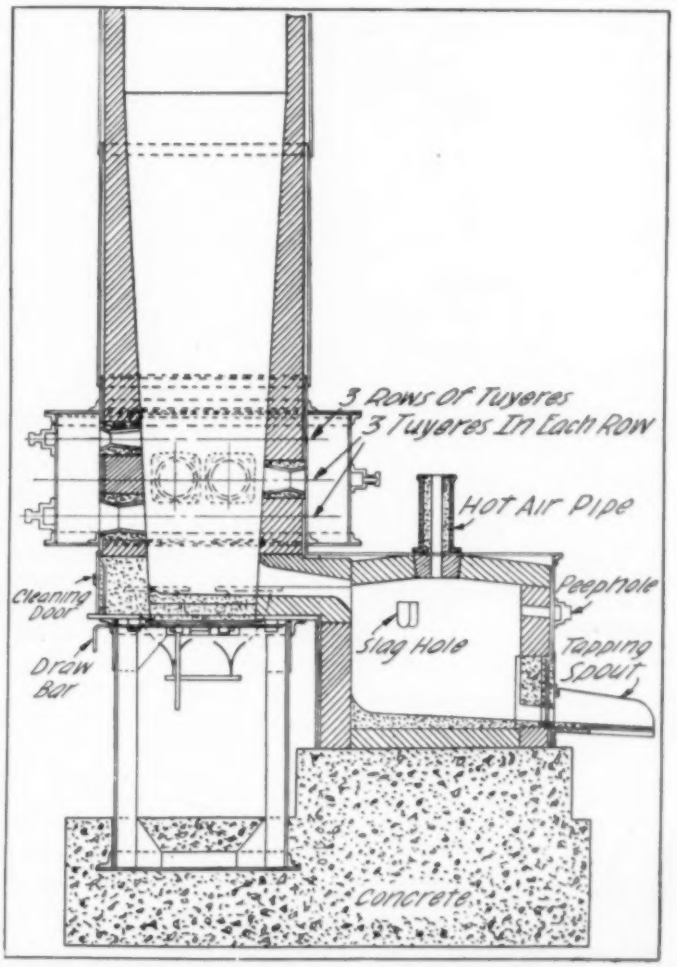


FIG. 1—CUPOLA WITH RECEIVER OF THE OUTSIDE TYPE—NOTE THE VENT PIPE AT THE TOP FIG. 2—SECTIONAL VIEW OF THE RECEIVER AND CUPOLA SHOWN AT THE LEFT

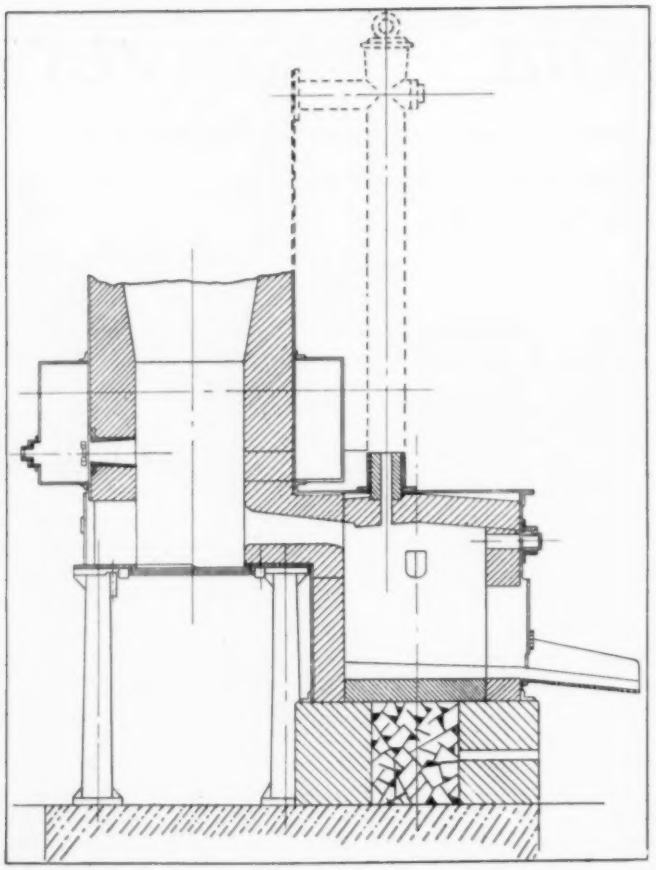


FIG. 3—DETAILED SECTION OF RECEIVER SIMILAR TO THAT SHOWN IN FIGS. 1 AND 2

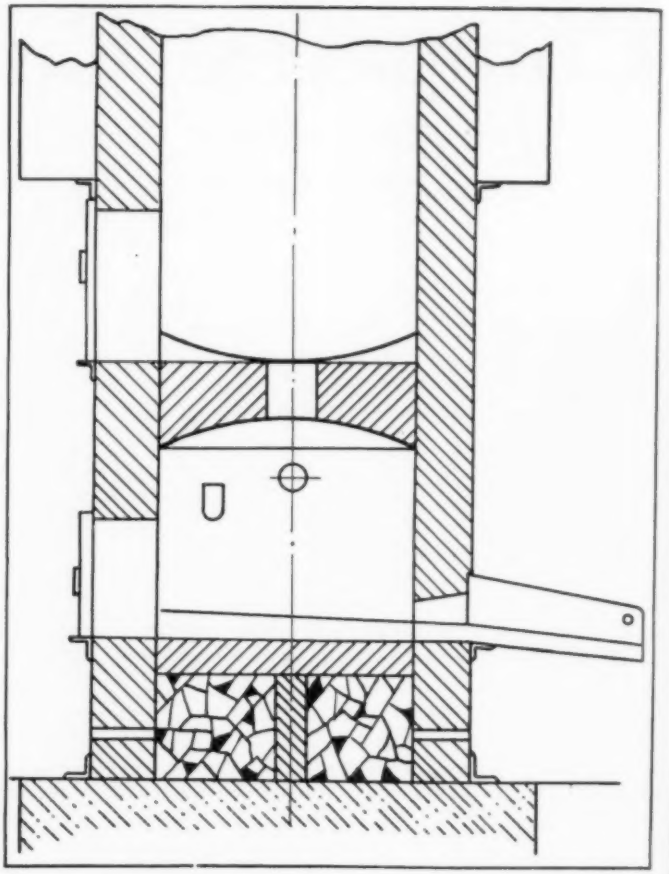


FIG. 4—RECEIVER OF THE TYPE LOCATED PERMANENTLY BENEATH THE CUPOLA

Second. The fact that as the metal melts, it drops immediately into the receiver, and so is removed from the possibility of taking up sulphur, etc., from the coke, where it would otherwise be lying.

Third. Better mixing is assured.

Fourth. It is also sometimes claimed that the receiver saves time, as the cupola bottom can be dropped immediately when melting has been stopped, although casting from the metal in the receiver may continue for some considerable time. One of the disadvantages in connection with the outside receiver, although this may be of a trivial nature, is that the passage from the cupola to the receiver may give trouble owing to the metal breaking through. Further it is somewhat troublesome to clean particularly in the small sizes. Attention is called to the fact that the vent pipe, which in the past used to pass from the receiver into the body of the cupola, has now been eliminated, and a short open pipe substituted. The question of this pipe is generally of more importance than is considered, but will be dealt with a little later.

Fig. 4 shows a section of the receiver, part of a cupola of the Matchell type, from which it will be seen that the receiver forms the bottom part of the cupola, the receiver being separated from the melting part by means of a dividing brick with a hole in it.

Figs. 5 and 6 show a cupola of a similar nature made by E. Roper & Co. but with many ingeneous refinements. It will be observed that these refinements consist of making the receiver portion separate, and distinct from the body of the cupola, which enables it to be withdrawn for cleaning, and does away with the opening at the side, and making up the same as is the usual case. The division plate between the cupola proper and the receiver is hinged, thereby insuring all the advantages of a drop bottom. This arrangement also does away with the hole at the back for removing coke, etc., saving a considerable amount of time in making up, and also allows a better distribution of the tuyers; as in the first instance shown of this type of cupola, the wind belt can go only partly around the cupola. The whole of the advantages claimed for

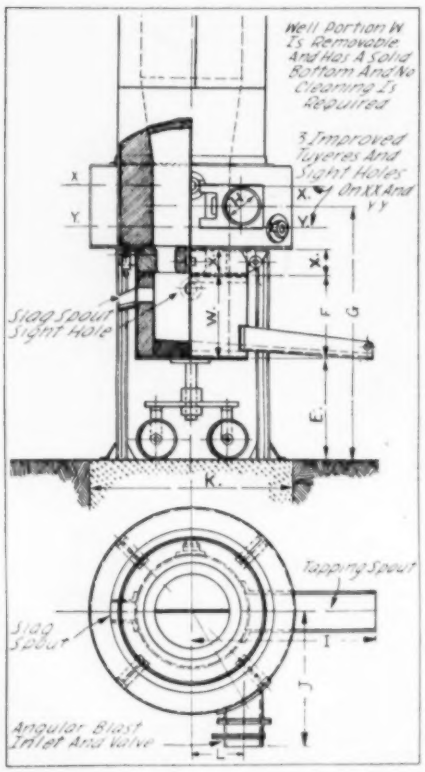

Well Portion W Is Removable And Has A Solid Bottom And No Cleaning Is Required
3 Improved Tuyeres And Sight Holes On XX And YY
X
Y
Slag Spout Sight Hole
Tapping Spout
Slag Spout
Angular Blast Inlet And Valve

FIG. 5—A TYPE OF RECEIVER WHICH IS REMOVABLE AND WHICH MAY BE PLACED BENEATH THE CUPOLA

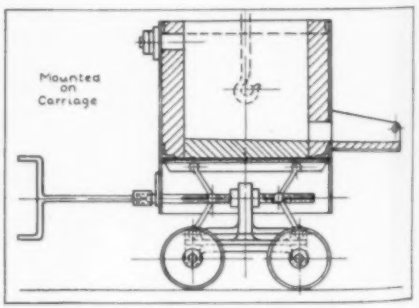


FIG. 6—DETAIL OF REMOVABLE RECEIVER SHOWN IN FIG. 5

the outside cupola apply equally to this. One of the objections to a receiver generally is the fact that more metal has to be melted before a satisfactory temperature is obtained than is the case with a non-receiver type cupola, owing to the fact that the brickwork of the receiver has to be heated. This cupola possesses advantages, from the fact that apt to become stopped the Thwaites now has an open vent, fumes from which are not objectionable.

Fig. 7 shows a receiver recently invented by J. E. Hurst, which is recommended for special work, such as cylinders, automobile work, diesel, and gas engine liners, pistons and heads. As will be seen, it consists of an outside electric furnace. The extent to which superheating can be carried, is limited and at first glance it appears as though the jets in this apparatus will give all the superheating which is advantageous. It also has advantages owing to the possibility of adding various alloys, which may be deemed necessary for special work, direct to the molten metal. So

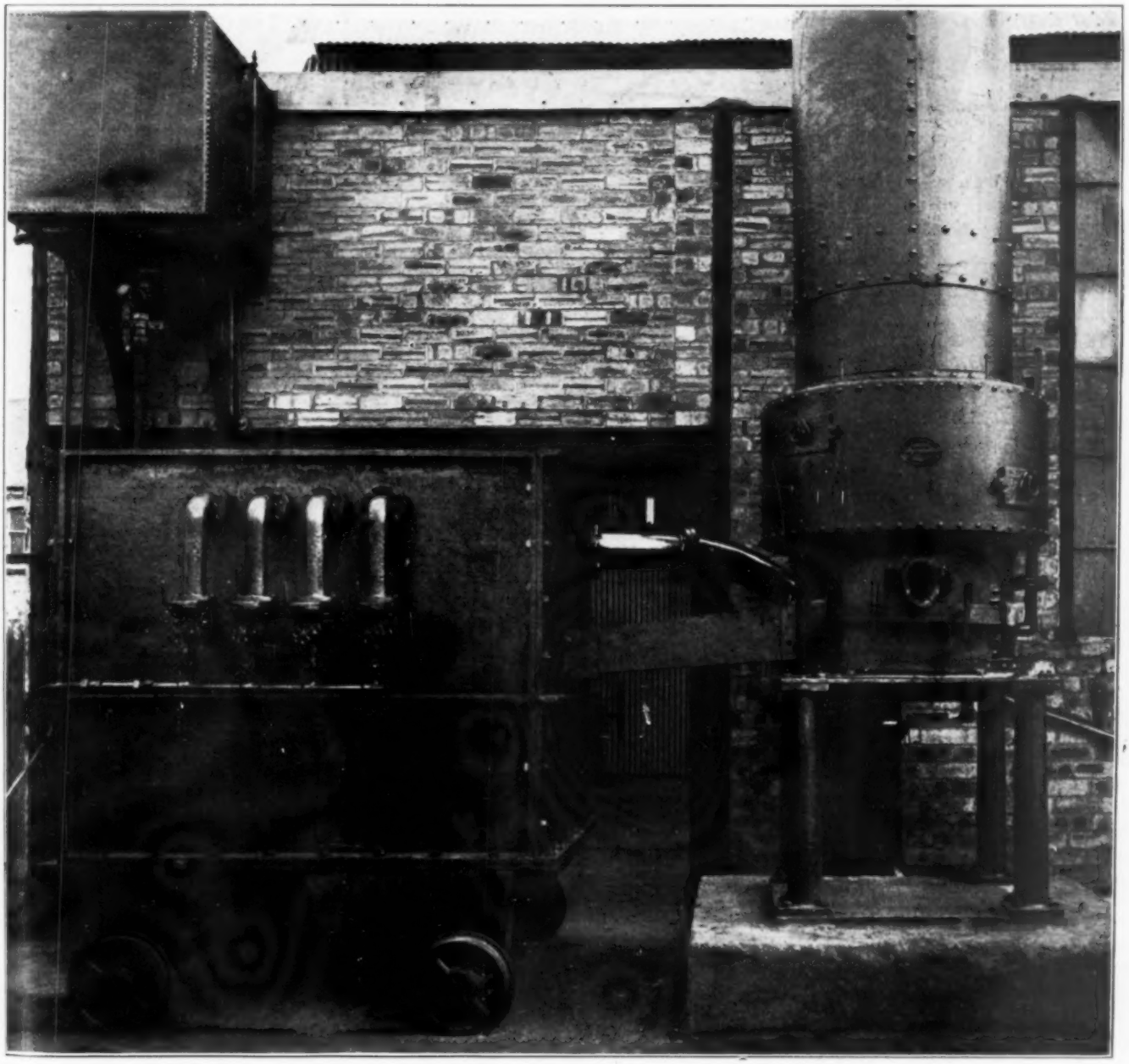


FIG. 7—EXTERNALLY PLACED RECEIVER WITH AUXILIARY OIL BURNERS FOR SUPERHEATING

the flame and hot gases are blown down directly onto the surface of the metal and slag, whereas the outside receiver has the flame directed to the side of the receiver. The importance of the vent pipe previously referred to, is to insure a regular circulation of heat. Without this vent pipe, the pressure in the receiver soon becomes equal to the pressure in the cupola, and no circulation takes place. Owing to the fact that without careful attention this pipe is

receiver, to which is added crude oil jets. The arrangement has all the advantages to be derived from coke consumption, etc., previously referred to but eliminates the disadvantage from cold metal at the start. It will be remembered the distinct advantage claimed by G. K Elliott, Lunkenheimer Co., Cincinnati, in his exchange American paper, which he said was derived from the superheat of molten metal before casting, in his case, was achieved in an

far, the receiver has been tried with an acid lining, and experiments are to be carried out with a basic lining, with a view to eliminating sulphur. As the chief aim is to superheat the metal, the method adopted is as follows:

Previous to putting on the blast in the cupola, the oil furnace is heated to approximately the temperature of the molten metal, using full burner power. When this stage is reached, the blast in the cupola is turned on and melting

started. The molten metal runs directly into the receiver and as the metal accumulates in the receiver it is subjected to the extra heat from the oil flame, and thus superheated. As the casting operation proceeds in the foundry and molten metal is drawn from the receiver, the temperature obtained reaches a high value, and it is found that it is possible gradually to reduce the burner power and maintain a sufficient degree of superheat with about 25 per cent of the burner capacity.

Coke Contact Eliminated

The next advantage of this receiver is of course the withdrawal of the metal from contact with the bed coke in the cupola, and the collection of a large number of successive charges of metal, thus tending to uniformity of the chemical composition.

The third advantage, and it is possible to give practical effect to this, is the chance to make additions to the metal as it lies in the receiver and vary the composition within limits.

Since the first adoption of this receiver the burner arrangement has been modified. The first device adopted for preheating the air, has had to be abandoned owing to the difficulty of getting pre-heater tubes to stand up to the high temperature conditions. Curiously, it has been found that there is no reduction in the efficiency of the receiver by cutting out the preheater arrangement.

The burner capacity has been reduced to 3 instead of 4 as first installed, and now gives a full capacity of 30 gallons per hour, and capable of reduction to a minimum capacity of ½ gallon per hour. The capacity of the bath in the cupola shown is 3 tons of molten metal, but so far has not exceeded 2 tons at any one time.

Consumption of oil will be an important matter in connection with this apparatus, and the following figures which have been supplied by Mr. Hurst are of interest:

FUEL CONSUMPTION OF SUPERHEATER TYPE RECEIVER

	Gallons of oil
Starting period (preheating)	
Burners full bore for 30 minutes.	15
Melting and receiving period.	
Total consumption over 5 hour cast.	31
Total oil consumption.	46

Oil per ton of metal = 2.56 gallons.

Cast iron from a cupola with a carbon content of below 3 per cent as is frequently desired, is practically an impossibility. However, with this type of receiver the carbon has been reduced with an addition of steel and alloy, to as low as 2.8 per cent in some cases.

Fig. 8, shows an arrangement attributed to E. Ronceray, P. H. Bonvillan & Ronceray, Paris, France, applicable to cupolas for light casting work, where the tap hole of the cupola is open for practically the whole of the blow. This consists of a brick as shown, containing a verticle and three horizontal passages. The process consists of working the cupola at the start in the usual way. When the metal is flowing freely through the lowest of the horizontal apertures the latter is botted up. The metal then rises inside the cupola and up to the vertical passage, until it reaches the second hole, which then is botted up in turn, the metal then rises within the cupola until the metal flows freely through the top horizontal hole.

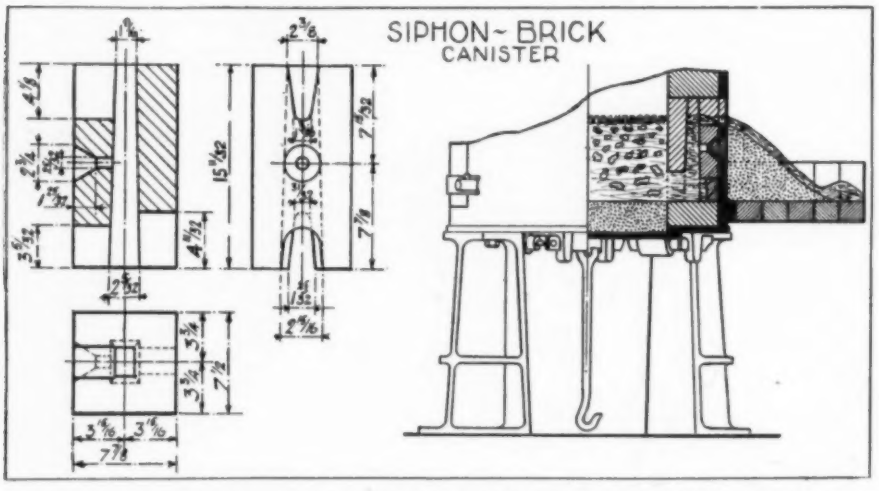


FIG. 8—SELF-CONTAINED RECEIVER OR SIPHON BASIN INTEGRAL WITH THE CUPOLA

Advantages claimed for this type are that the metal is being bottom poured from a considerable mass of metal, which insures better mixing than usually is the case. However, it has been found that metal must be drawn off before the temperature in the well of the cupola is sufficient to insure good work.

In conclusion it may be said that receivers are essential where well mixed metals of an uniform character are desired. They are more economical in coke consumption. Receivers inside the cupola show, as distinct from one outside a less disadvantage of cooling of the first metal. An important point to watch in this direction, is that there is a good circulation of heat up the vent pipe, otherwise the best results will not be obtained.

Research Association Has Issued Report

The first annual report of the British Cast Iron Research association, which has just been issued, shows that the membership now consists of 202 British iron foundres. The report, which takes the form of a 16-page booklet, reviews the work of the first year of the association. Among the subjects now being studied are molding sands, refractories, automobile cylinder castings, malleable castings, and shrinkage defects. The statement of accounts which accompanies the report shows the association to be on a strong financial basis. The association enters its second year with the officers practically unchanged, Lord Weir of G. & J. Weir, Ltd., Glasgow, is president; H. B. Weeks of Vickers, Ltd., Barrow-in-Furness, chairman of council; F. J. Cook of Rudge-Littley, Ltd., West Bromwich, and M. Riddell of Watson, Gow & Co., Ltd., Falkirk, Scotland, are vice-chairmen of council; and Thos. Vickers is secretary. Dr. Percy Longmuir of Sheffield University has just been appointed director of research.

Purchase New England Foundry Interest

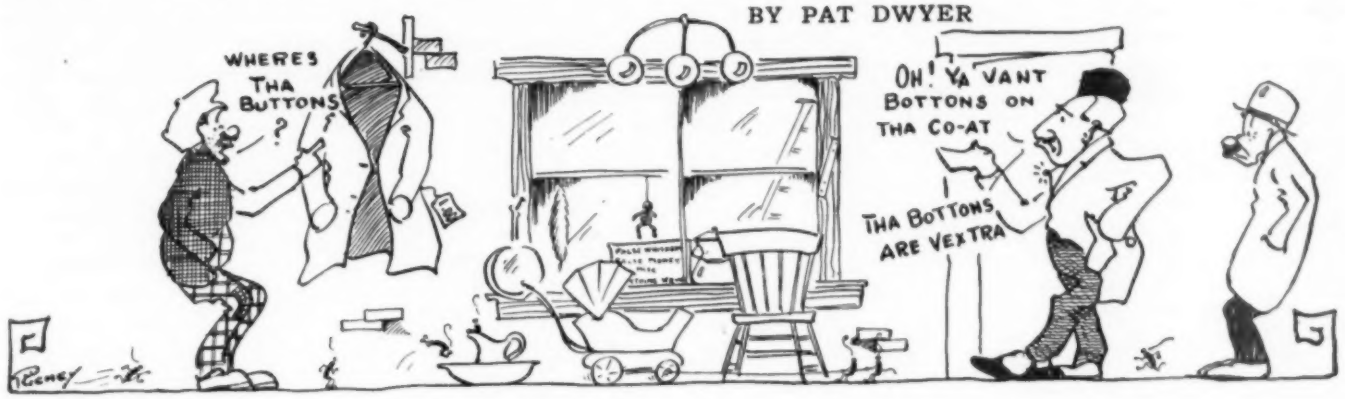
The Turner & Seymour Mfg. Co., Torrington, Conn., makers of drapery and upholstery hardware, egg beaters, chain, etc., has been purchased by Wm. R. Bassick, H. L. Sutton and Willard L. Case. Mr. Bassick, who was chosen president, formerly was vice president and general manager of the Bassick Co., Bridgeport, Conn. Mr. Sutton, vice president, was general manager of the American Tube & Stamping Co., while Mr. Case, who becomes secretary-treasurer in the new organization, was treasurer of the Yale & Towne Mfg. Co., Stamford, Conn.

George Oldham & Son Co., Baltimore, manufacturer of pneumatic tools has established a branch office at 608 National building, Cleveland. This office will be in charge of W. W. Davidson and C. M. Hartzell.

F. A. Coleman Co., Cleveland, manufacturer of coke ovens, is constructing an addition to its structural and stock departments.

Bill Questions the Wisdom of Solomon

BY PAT DWYER



SOLOMON is credited with the statement that there is nothing new under the sun. To avoid any possible misunderstanding it might be well at this point to intimate that the reference applies to the original Solomon; the one, in a manner of speaking, with the name blown in the glass, infringements prosecuted. I feel that I can do no less than offer this simple explanation, otherwise you might be justified in assuming that I was quoting the gentleman who kept the shop on Charles Street and who, under the name of Solomon Levi has furnished an excuse for glee clubs and other equally obnoxious species of amateur singers to make the welkin ring. If we are to accept the words of the touching and sentimental ballad at their face value we gather that Mr. Levi was a dealer in old clothes and other second hand equipment and therefore he would be *justified* is assuming the view that there is nothing new under the sun. Nay, further, in this land of the free and the home of the brave, nothing prevents him from airing his views.

He may have used the expression with both hands and many times a day, but if so, there is no record to that effect. Look up Solomon in any encyclopedia and you will find no reference to Solomon Levi, but you will find quite extended reference to Solomon the king. According to all available accounts he was responsible for practically everything worth while that was said during his period of existence here on earth. When you consider the character of the establishment he maintained, you naturally will wonder where he found the time or the opportunity to say anything except: "Oh! for heaven's sake, shut up once in a while and let a guy say a word, will you?"

This thought leads us gradually and as it were by easy stages, over the desert to the suspicion that perhaps he maintained a staff of contributors or assistants, a kind of a press clipping bureau and publicity department that gathered up everything worth while and credited it to the old boy. The supposition is not so far fetched as it may appear. In fact, without unduly straining your memory you probably can recall some person within your own recollection whose reputation for wisdom is built on a somewhat similar precarious and fictitious foundation. Solomon appears to have the edge on all competitors in that his reputation has survived for the longest period of time, but it is an open question in my mind whether his notoriety as a ladies' man has not done much to keep his memory alive.

However, that is neither here nor there. I accepted for many years at their face value all the vague stories clustering around King Solomon, his times and his doings. While admiring his bravery, I have at times reflected that his attempt to corner the feminine market of the word redounded more to his taste as a beauty specialist than it did to his ordinary common sense. Recently, while visiting the public library, my attention was directed to a reprint of an old book dealing with the ancient lands bordering on the Red sea. Several chapters were devoted to a presumably accurate account of one of Solomon's adventures in which the Queen of Sheba played the unwilling party of the second part and as a result I have reindexed the old sheik in my mind as a crafty old knave.

It may be that I am doing him a rank injustice, but since there is not the remotest possibility that his clipping bureau—if he had one—will bring this opinion to his attention, I have no hesitation in stating my convictions. This brave and hostile attitude on my part further is strengthened by the belief that none of his contemporaries, friends or acquaintances, is now living and therefore any opposition that may develop will experience a considerable measure of difficulty, probably actual and bitter disappointment, in producing character witnesses for the accused.

Perhaps he said there is nothing new under the sun. Perhaps some other person said it. The point really is immaterial. Some person certainly coined the expression. The only really essential point to be considered is that the phrase, at least in so far as it applies to human feelings, emotions, passions and the relation of one human being to others of his species, is absolutely true. Ever since I have been old enough to do a little thinking on my own account, I have held fairly consistently to this opinion and I am glad to say that a recent experience of Bill's has converted him to the same view and has confirmed me in mine. "You remember the story of that gink, Ulysses" said Bill "and the manner in which his son Telemachus assumed his share of the quarrel and helped his father drive the unwelcome visitors out of the ancestral hall. Well, I had a somewhat similar experience the other day. No blood was shed and black murder and

SLIGHTLY VARIED FROM THE ORIGINAL VERSION

sudden death did not shake his gory wings over the scene, but my son came to my aid in what you might call a crucial moment in just as instinctive and satisfactory a manner as that in which Telemachus ranged up alongside his father on that memorable occasion when the old boy showed Penelope's suitors who was who, in his own house.

"Several episodes in the late Mr. Homer's long drawn out story incline me to the opinion that he was levying freely on his imagination, but the scene dealing with our hero's return in disguise as a beggar, just to give the situation the once over before declaring himself, struck me as quite natural. When a man has been away from home for twenty years he cannot be too careful on his return. In this instance the situation was further complicated by the fact Mrs. Ulysses never had a telephone installed in her residence, telegraph wires were down everywhere and the postal system was all shot to pieces. Ulysses did a little quiet scouting around the house and barn, asked the inside help and the hired man a few discreet questions and then happy in the discovery that the lady Penelope still held him in esteem and never had ceased to grieve for his return, he oozed into the kitchen with a view of declaring himself at the most opportune moment during the evening's festivities.

"The occasion arrived sooner and in more dramatic manner than he had anticipated. Penelope, paragon of marital fidelity, by many a clever subterfuge had repulsed for many years the advances of her many suitors. On this particular night she thought up a new stunt that showed she was a fit mate for her distinguished warrior husband. She remained a gracious lady, calm and smiling, throughout the ordeal and beyond occasionally, touching her jeweled side combs with the tips of her dainty fingers, she manifested no alarm when the wrecking party started to work. The eyes of love are keen and bright and her little test confirmed her intuition that the beggar's rags covered the form of her long lost lord. The same test afforded Ulysses an opportunity of proving his identity and incidentally pounding the everlasting tar out of a bunch of yahoos who had been annoying his lady during his absence.

"She announced that she at length reluctantly had given up hope of her

MUSIC HATH CHARMS—SOMETIMES

man's return and would wed the one among her guests who could bend the great war bow Ulysses had left behind when he had departed twenty years before in the general direction of Troy and points East. Several guests tried without success and then the seeming beggar stepped forward, as of course—she all the time knew he would. He seized the great bow with one hand and adjusted the cord with the other. The minute he twanged the string a conviction sank into the minds of the men sitting around the banquet hall. They realized that they would have to jump quick and sudden; they either must kill him or be killed by him. They seized their weapons to make a concerted attack and then found they were confronted not by one man but by two.

"Telemachus, newly returned from a year's futile search for his father was an interested spectator and suspected nothing until he saw the bow bend and the cord snap into place. He was a baby in the cradle when his father had sailed away from Ithaca, he had no personal recollection of his appearance and no message ever had been received from the wanderer; yet now, thanks to his mother's training and his own filial instinct he knew that the man standing alone on the platform, facing sudden death, was his father. Knew it as well as if he had walked by his side and talked to him all the days of his life. His shout as he leaped, sword in hand, to his father's side was as much an indication of recognition, pride and love for a parent as it was one of defiance to men launching the attack. The idea of personal danger never entered his mind, or if it did, instantly was dismissed in the face of the fact that here was his father in imminent danger, a father he had come to know intimately through the adoring eyes of his mother. Why linger over the gory details? Father and son stood side by side, the one a replica of the other and waged what is regarded by connoisseurs as one of the prettiest engagements ever recorded. Each time the great war bow hummed one of the assailants experienced the highly unpleasant sensation of feeling a streak of lightning in the shape of an arrow about a yard long whistling through his engine room and putting his pumps and lighting system out of commission. He went down with all hands, a total loss. Those who pressed too close had their heads neatly severed from their bodies at the second vertebra joint by a young man with the lust of battle in his eyes and the giant strength of his father in the hands that whirled aloft a dripping, vengeful, and two-edged sword. Believe me, what they did to those birds was a plenty and I think we safely may asume that after the little detail of house cleaning was at-

ILLUSTRATING HOW READILY A MISSAL INSIDE THE CHURCH MAY BECOME A MISSILE ON THE OUTSIDE

tended to, the happy, reunited family lived in peace and comfort ever afterward.

"My recent experience was a trifle different from the foregoing, but it serves to bear out the contention that there is nothing new under the sun in so far as a son's instinct to stand by his father is concerned. One of my sons sat by me at divine service last Sunday and we both joined to the best of our ability—which is not saying much—in the congregational singing. At the close of one verse the organ continued and I assumed that we were to sing the second verse. I shouted the first words of the opening line before I discovered to my horror that I was alone. My embarrassment was not relieved by the many amused glances thrown in my direction. The man sitting next to Bill Jr. almost choked in his violent endeavor to control his mirth and I can assure you I would have considered it a rare privilege and pleasure to act as one of his pall bearers. I was bitterly aware that my pitiful attempt to assume an easy and nonchalant expression deceived no one. Those in front were too polite to turn around, but I could feel the hundreds of eyes behind boring into my crimson neck and ears.

"I know at least one person who paid no attention to the sermon that day. I spent the entire time in revolving in my mind the most fiendish forms of torture I should like to inflict on the addle pated bird who enjoyed a fresh convulsion every few minutes.

"Everything comes to an end sometime and we finally stood up for the closing hymn. I made no attempt to sing, but stood there in humiliation with my eyes modestly cast down and thereby missed an interesting little bit of by play. My friend, the enemy, placed his hard hat on the seat and Bill Jr. whose eyes were not cast down, immediately seized the golden opportunity. He edged the hat over until it was directly back of himself and when the hymn was over he sat down—violently. He jumped up again, horrified and apologized profusely for the accident and I can say in all sincerity that the look on the owner's face as he accepted the wreck, was Balm of Gilead to my lacerated feelings. On the way home I reproved the young fellow, but I am afraid he was not overly impressed. He grinned at me impudently and admitted that while the shouting incident almost had caused his own death, he did not propose to see any monkey-faced, tub of cheese laugh at me and get away with it. A dutiful son is sure a great consolation.

"In looking over a foreign foundry journal the other day I read a description of a job that furnishes additional evidence of the truth of the old saying that there is nothing new under the sun. I made a similar job several years ago and the author of the article to which I refer states that when they broke an old casting they discovered that some old dead and gone molder, had the same idea probably 100 years ago.

"I was asked to make a cast iron nut approximately 6 inches diameter by 12 inches long, with a coarse, square thread cast in. Like my friend I anticipated no trouble in using the old casting for a pattern and the threaded 3-inch shaft for a core and also like him I found after the casting was poured that while the shaft appeared to be free, I could not screw it out. The casting was broken off and then I found that the screw probably had been formed by hand. It was fairly symmetrical but not sufficiently accurate to turn in the close fitting thread formed in the casting. The shaft was taken to the blacksmith shop where the blacksmith heated a piece of 1 x ½-inch square bar and wound it in a spiral around the shaft in the spaces between the threads. The shaft then was removed and the spiral was placed in a 4-inch stock corebox 14 inches long where it was rammed full of core sand. The core was dried and then the sand was filed away between the threads and at each end until the diameter of the core was slightly larger than the diameter of the shaft on the outside of the thread. In this manner the exposed part of the steel spiral was designed to be anchored firmly in the casting, while the part bedded in the core, later would serve as a working thread after the core sand was cleared away.

"A wood plug was driven into the opening in the casting and allowed to project 1 inch at each end to serve as a core print. The mold was made and poured on end to prevent any deflection of the core due to the pressure exerted by the molten iron. The core received a good coat of blacking after it had been filed down to the proper diameter and just before the core was placed in the mold the blacking adhering to the spiral was removed. The metal surface was rubbed clean with emery paper and then coated lightly with kerosene oil to prevent any condensation of moisture before the metal was poured in the mold. On the following morning the casting was cleaned, the thread greased and no trouble was experienced in working the shaft from end to end. Up until recently I considered the idea original with me. Now along comes this man from across the sea with a similar claim and also the admission that some old forgotten artisan had beaten him to it by nearly 100 years. Verily, of a truth there is nothing new under the sun."

"All that may be true;" I said, "but what I should like to know is, did you buy your jolly friend a new hat?"

"I did not," quoth Bill. "Indeed I consider that the most regrettable feature of the entire incident. I hung around outside for some time hoping that he would be silly enough to approach and make a request of that character, or in fact of any character; but I was disappointed. It would have given me the most sincere pleasure to massage his face in a suitable manner to match his hat."

Seacoal Facing Produces Clean Castings

Question—We should like to know the advantages derived from the use of seacoal with particular reference to its application to brakeshoe castings. We understand that seacoal makes the sand peel off better and also has a tendency to open the sand to a certain extent. We should appreciate your advice on what grade of sea coal to use and also whether there are any other advantages or disadvantages.

Answer—From your communication we note that you are familiar with the purpose for which sea coal is used in the foundry viz: to open the sand and produce a clean skin on the casting. If your brakeshoes are sandblasted or cleaned in tumbling barrels you do not need to add seacoal to your facing sand. Castings made in sea coal facing require little or no cleaning and the question whether the cost of the sea coal and the time required in the preparation of the facing, outweighs the extra time required to clean castings made in plain sand, by tumbling or sandblasting, is the determining factor in the problem.

Sea coal is not graded. It may be purchased from any of the foundry supply houses and practically is uniform all over the country. Several foundries in a position to do so, grind their own sea coal facing in a simple form of ball mill. Almost any bituminous coal may be used, but naturally the coal with the highest carbon content and the lowest ash and sulphur, will produce the most satisfactory facing.

The North & Judd Mfg. Co., New Britain, Conn., has reopened the foundry and other departments of the former plant of the W. & E. T. Fitch Co., in New Haven, Conn., purchased in 1919.

Offers Simple Test for Sand

Chicago Foundryman Devises Means for Separating Sand from Bonding Material Mechanically—Method Is Demonstrated at Session of Technical Club

Eugene W. Smith Method for Testing Sand

USE a 10 or 12 ounce clear glass bottle, 1¼ inches in diameter, 6 or 8 inches high, the same as is in common use for oil samples.

Rub the sand lightly to remove the lumps. Fill the bottle one quarter full of the material to be tested.

Fill the remainder with clear cold water and shake thoroughly.

Stand the bottle on any foundry vibrator plate, hold down firmly and vibrate until the heavy grains are all down. Then allow it to stand until the water becomes clear. The bond *and* silica *will be found divided by a distinct line.*

Provide a small rule, the inches divided in tenths.

When the solution is fully settled measure the total, then measure the bond, *or upper part, followed by the* silica *at the bottom.*

Divide each by the first figure. The result will be the percentage of either.

The presence of yellow *will indicate alumina oxide and* red *the iron oxides. Sometimes both are distinctly shown in the sample, but in many cases their presence is shown only by the varying shades.*

The fineness may be determined easily by general observation.

PRESENTING an exhibit of 120 samples of molding sand physically analyzed by the vibratory precipitation method, with 52 other samples not tested, and a demonstration of the method, Eugene W. Smith, Crane Co., Chicago, who has been working on sand analysis through most of the present year, addressed the Chicago Foundrymen's Club at its December meeting.

After reading a paper on molding sand before the club early in the year Mr. Smith began to study the subject with special relation to the needs of the molder and after separating the sand and the bond by precipitation in water found that placing the bottle on a vibrator brought down the sand more rapidly and obtained a better separation, the bond remaining in suspension longer and depositing above the sand in a sharply separated band.

Mr. Smith spoke as follows in setting forth his method of handling sand:

"The selection of sand for foundry use has been an annoying problem for all concerned in the past. This annoyance has been due mainly to the lack of some reliable means of determining—

The *bond* to insure its strength for making the mold and wearing qualities.

The silica content, for porosity, sufficient to relieve the gases formed when the metal is poured.

To have sufficient fineness of grain to assure a proper finish to the surface of the castings when cleaned.

"To make conditions more uncertain there never has been devised any common form of comparison available to the foundrymen, the management, the purchasing departments and the producers.

"In presenting this exhibit and new method for determining the characteristics of molding sands, I wish to impress upon your minds one thought. That is that no part of this discussion or exhibit must be considered as antagonistic to any other method, whether chemical or physical. I realize fully the vast amount of research already given to this subject by others, particularly along chemical lines and it is intended that this should *add* to, that which has already been accomplished by others.

"There is much to be done yet in research of molding sands, particularly by those who have the time and incentive, students in our universities and technical schools, particularly along geological lines of study. Geology treats of the formation of rock, from nature's manipulation of the sand, also the formations of sand by the disintegration of the rock, but little is said regarding the uses of sand and its fitness for commercial purposes.

"My studies of the specimens shown have led me to almost revolutionary thoughts regarding theories advanced and generally accepted in the past. For instance, I would advance the question, are alumina and iron oxides only *secondary* in forming the bond in sands? Are they simply indicators by their presence and color, of the grade of fineness?

"One phase of study of the vibratory test, brings out the silica deposit, showing the heat resisting qualities of the sands by determining the original class of rock from which it comes. In explanation, Albany, North River, some of New Jersey, also a few Ohio sands, show the presence of black volcanic rock, indicating by its presence high heat resisting qualities. Again, those sands which show strongly the presence of mica schist, some Ohio, Tennessee and California sands, show this characteristic, indicating a high heat resistant. By the foregoing remarks it may be seen that the vibratory method of separat-

Producers Who Gave Sand for Testing

George F. Pettinos.....Philadelphia
J. W. Paxson Co.....Philadelphia
P. H. Collyung.....Bridgeport, Conn.
Whitehead Bros.....New York
Northern Refractories Co....Ridgeway, Pa.
The Burton-Townsend Co....Zanesville, O.
The A. F. Burton Co.....Springfield, O.
Houghland & Hardy.....Evansville, Ind.
W. T. Mahony.....Chattanooga, Tenn.
The Newport Sand Bank Co..Newport, Ky.
The Garden City Sand Co.....Chicago
W. S. Perrigo.....Beloit, Wis.
E. C. Townsend.....Montreal, Canada
D. B. Davies Mineral Supply Co...Chicago
S. T. Johnson, Obermayer Co.....Chicago
Material Service Corporation.....Chicago
Southern California Development Co.
.....San Diego, Cal.
Badd Mountain Quarries Co.....
.....Winston-Salem, N. C.
Ed. E. Squier Co.....St. Louis

ing the *bond* from the *silica* affords a means of study along new lines.

"To the chemist the word *silica* as used in connection with the vibratory test is only meant for that portion of the specimen which is precipitated by vibration; and that which is held temporarily in suspension is classed as the *bond*.

"There are in the collection shown about 100 specimens ranging from clear, washed river sands, showing no bonding qualities whatever and only used for sand blast, to the strongest and best known sands for steel and heavy machine castings, including the best known grades of *fine* sands in the country. Also a few specimens of sand used each day, are shown giving the variations and demonstrating the value of the method in testing old sands."

For daily foundry observation of sand from the molding floor a rack with six bottles is provided, one for each day of the week. The proportion of bond and sand, as it varies from day to day, is shown clearly and necessary additions of one or the other to return the sand to its ideal condition can be made as needed. Reading the curve of variation is an interesting proceeding and the effect of this method of analyzing the sand gives new interest to foremen and molders.

The session of the Chicago Foundrymen's Club attracted much interest and visitors from as far away as Birmingham, Ala., Cincinnati and Davenport, Iowa, were present. The exhibit of sands was made possible by co-operation of the producers named on page 34, to whom thanks was given by vote of the club.

Development of Steel Ladle Stoppers

SINCE the introduction of the bottom-pour ladle the methods of preparing the stopper and stopper rod have passed through some interesting developments. Where the nozzle may be opened from 20 to 100 times during the progress of pouring a ladlefull of steel it is apparent that the stopper must be properly designed to withstand such severe service and also that it must be attached to the stopper rod permanently and securely. Some steels, particularly 12 per cent manganese steel, show a tendency to *cut away* the stopper and nozzle brick and since the cutting is not done uniformly, small furrows and channels develop and sometimes cause a serious leak. Therefore it is essential that the stopper be made from highly refractory material and one not subject to erosion from basic metal. Several types of stoppers are shown in the accompanying illustration and attention is directed to the weak features in each one. The type of stopper shown in Fig. 6 has been in use for over a year at the Krieger Steel Works, Dusseldorf-Oberkassel, Germany, and has given satisfactory results.

Tension Causes Breakage

Where the metal shows a tendency toward pastiness, due usually to being tapped below the proper temperature, or to being held too long in the ladle, the steel will freeze in the angle *a* between the stopper and the nozzle. Under these circumstances it becomes extremely difficult to raise the stopper rod and in extreme cases the nozzle becomes permanently plugged. The lower part of the stopper will tear off at the line *L1 L2*, or, within 1 centimeter (approximately 2/5-inch) above. Sometimes a pricker may be employed to force an opening through the nozzle from underneath and the remainder of the steel in the ladle may be controlled by that part of the stopper remaining on the rod.

In the stopper shown in Fig. 2 an unthreaded bolt provided with a head at one end and a slot a short distance from the other end is inserted through an opening in the lower end of the stopper. It is pushed in until the head comes in contact with a shoulder in the opening. The upper end by that time projects above the stopper and is inserted into a suitable opening in the end of the stopper rod. A flat, tapered key driven through the slot in the bolt and corresponding slots in the rod, hold the stopper firmly in place. The opening below the bolt head is packed full of daubing and the usual sleeves are employed to cover the stopper rod. Under operating conditions no force can be exerted sufficient to shear the cylinder *ABCD* and thereby tear the bolt out of the stopper. However, if the daubing falls out of the opening below the bolt head, or, if the key works loose the stopper will not fit the nozzle snugly and it will be impossible to shut off the stream.

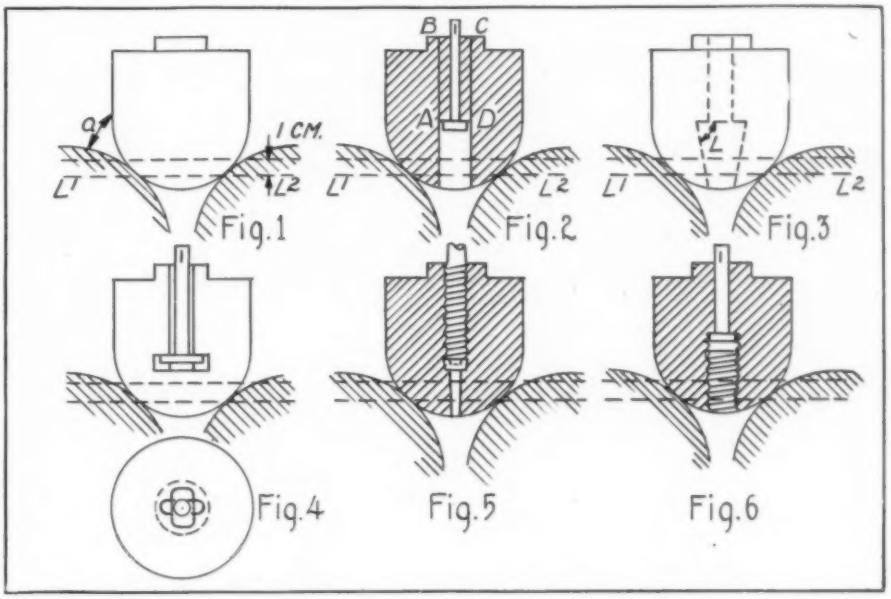


FIG. 1—LINES SHOWING PROBABLE FRACTURE PLANE FIG. 2—THE OPENING BELOW IN THE BOLT HEAD IS FILLED WITH DAUBING MATERIAL FIG. 3—THE STOPPER IS WEAKENED BY THE ACUTE ANGLE AT *L* FIG. 4—THE BOLT IS TURNED AT AN ANGLE OF 90 DEGREES FIG. 5—STOPPER IS SCREWED ON STOPPER ROD FIG. 6—PLUG IS SCREWED IN OPENING AFTER STOPPER IS KEYED TO STOPPER ROD

The shape of the opening in **Fig. 3** prevents the daubing from falling out, but on account of its large diameter at *AD* and the tendency to split presented by the angle *L* the stopper is weakened. Another solution of the problem is indicated in Fig. 4 where a bolt with a rectangular head is dropped through a slot into a circular opening in the interior of the stopper. Once in place it is turned through an angle of 90 degrees so that the projecting sides

Abstracted from *Stahl und Eisen* by Pendleton Powell.

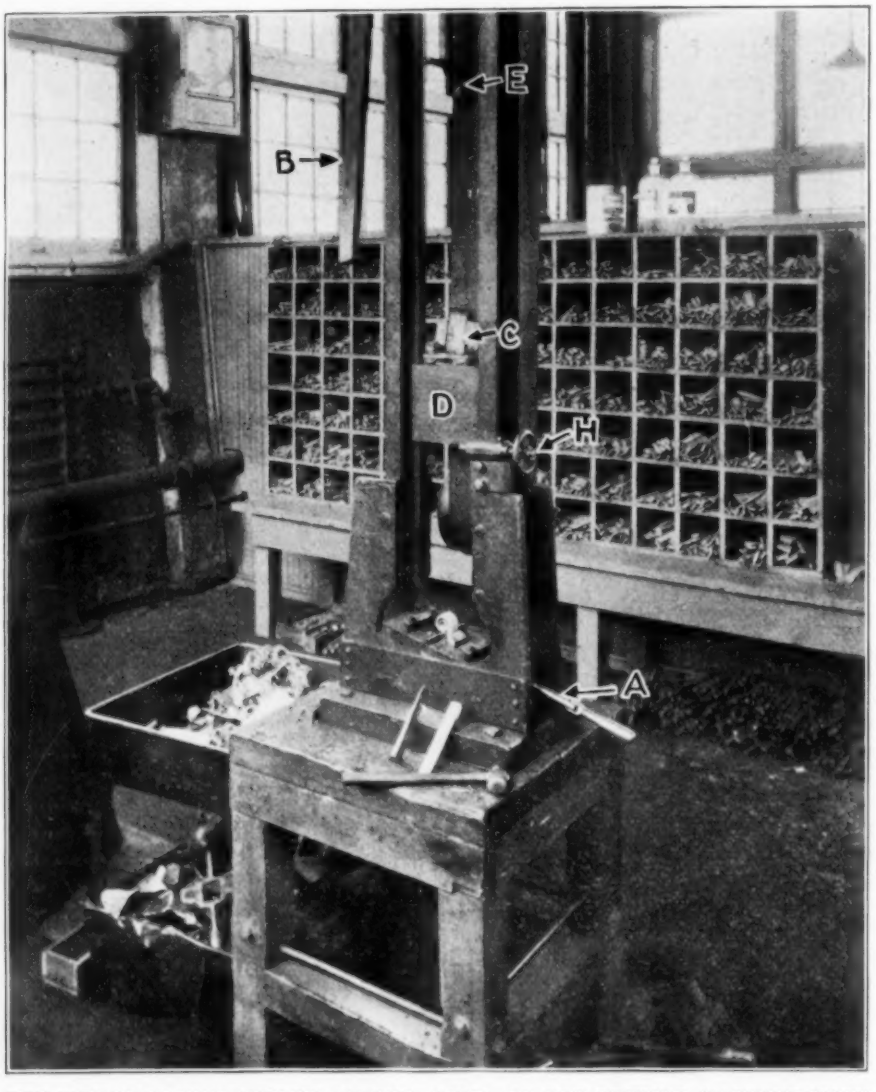
of the bolt head will engage the lip of the circular opening. Carelessness in setting the bolt head properly, constitutes the greatest risk in using this style of stopper. On account of temperature changes, cracks and flaws are developed through the axial position of the opening in the interior of the stopper. Also the sharp interior corners promote cleavage in the event that the stopper *sticks* in the nozzle as mentioned.

A strong stopper and one that is not affected by rapid changes in temperature is shown in Fig. 5. However, great skill is required to set it properly. The thread on the stopper rod and that on the stopper must be in intimate contact through their entire length to insure proper support and prevent stripping. It is extremely difficult to produce true threads on the interior of the stopper on account of distortion while heating.

A combination of the method employed in Figs. 2 and 5 is shown in Fig. 6. The bolt is keyed to the stopper rod, but instead of filling the remainder of the opening below the bolt head with daubing, which later may fall out, a solid plug of refactory material is screwed into place.

Applies Drop Test to Malleable Wedges

QUALITY of malleable iron is measured in specifications by tensile tests which indicate in exact figures the number of pounds pull a standard bar will withstand and the percentage it will elongate in a length of two inches. These requirements gradually have been increased by the American Society for Testing Materials in their specifications for malleable castings, until they are now at 50,000 pounds per square inch for tensile strength and 10 per cent elongation in 2 inches, having once been as low as 40,000 pounds per square inch tensile strength and 2½ per cent elongation in 2 inches. These higher specifications, once difficult or impossible for many malleable iron foundrymen to meet, are now readily attained in daily practice.



THE WEDGE SHOWN CURLED ON THE ANVIL OF THE TESTING MACHINE WITHSTOOD THIRTY 70-FOOT-POUND BLOWS OF THE TUP WITHOUT CRACKING

Naturally the consumer seldom goes outside of the requirements of the specifications for testing the iron, but these are so high that the producer finds it advantageous to take every precaution to assure himself that the quality of his iron is all that could be demanded. To this end many foundries are equipped with the Walker drop-test machine, as modified by the American Malleable Castings association under the directions of their consulting engineer, Enrique Touceda. This test gives an indication of the shock-resisting property of the metal.

One of these machines installed at the works of the Dayton Malleable Iron Co., Dayton, O., is shown in the accompanying illustration. This machine, by dropping a weight giving a 70 foot-pound blow on the end of a wedge-shaped test piece, starts to curl the piece, and future blows continue the process until the wedge is bent around several times and rests on the block holding it, or until the test piece breaks or cracks. It is considered satisfactory if the piece will stand 20 blows of the weight before cracking, but the Dayton company continues to drop the weight until the piece cracks or 30 blows have been given.

Makes Many Tests

The accompanying illustration showing the rack of test pieces in the background gives an idea of the vast number of tests made by the Dayton foundry. Each test piece has cast on it the date it was poured, giving the day and month, also the furnace number and heat number it represents. The two wedges on the bench in front of the machine show the shape of the piece. The straight side is 1 x 6 inches and the tapered side is ½-inch wide at the base and ⅛-inch at the tip. The piece shown curled in the vise has withstood 30 blows of the hammer without cracking.

Before the piece is clamped in the holder the tip is bent slightly with a hammer so that the weight when it falls will continue the bend instead of giving a straight upsetting blow. The piece is set in a pivoted vise at the base of the machine. The one jaw of the vise is

fixed permanently to the base of the vise and the other jaw moves on a groove, being controlled by a threaded rod. The end of this rod may be seen at *A*. The hinged handle is swung at right angles to the rod when screwing the jaw of the vise to hold the test wedge. When in a straight line with the rod the handle serves to hold the vise at any desired angle.

To start the machine operating, the belt is slipped from the idle pulley by the lever. This puts the belt behind the trip in operation, and when a cleat attached to the belt comes behind the trip it engages another cleat on the spring, *C*, carrying the weight with it. The operator then screws back the rod which had been supporting the trip, by turning the hand wheel, *H*. When the spring reaches the stop *E* it is forced forward by the stop and disengages the cleat on the belt which allows it to fall on the test piece. It is raised again when the cleat on the belt comes to it and is dropped automatically by the stop. This is continued until the test piece cracks or 30 blows have been given. During the test the operator holds the rod *A*, and by it controls the angle of the vise so that the test piece is in a vertical position when the weight strikes it. This minimizes the cross bending effect.

Rolling Mill Spindles Cast on End

BY M. E. DUGGAN

MANY patternmakers would be surprised if they were given the opportunity of following their pattern into the foundry and observe how the foundryman adapts it to meet peculiar foundry conditions. Sometimes the pattern is sent back to the pattern shop to have certain changes made and then the patternmaker has a chance to learn the cause of the foundryman's objection. At other times the foundryman says nothing, changes the pattern, or the method of molding, and the patternmaker is none the wiser. At one time I made a spindle pattern for a rolling mill and in the absence of instruction or knowledge to the contrary, I split the pattern through the center longitudinally so that the mold could be made horizontally. Apparently the pattern was satisfactory. It was sent to a neighboring foundry on several occasions to have castings made off it and the foundryman never lodged any protest. I saw the castings when they were delivered and happening on one occasion to examine one closely I noted that there was no longitudinal joint mark, but that there was evidence of a fin chipped off all around one end. Further I discovered that a riser had been knocked off one end and there was no evidence of any riser on any other part of the casting. Later in conversation with the foundry foreman I learned some facts about spindles with which I had not been familiar.

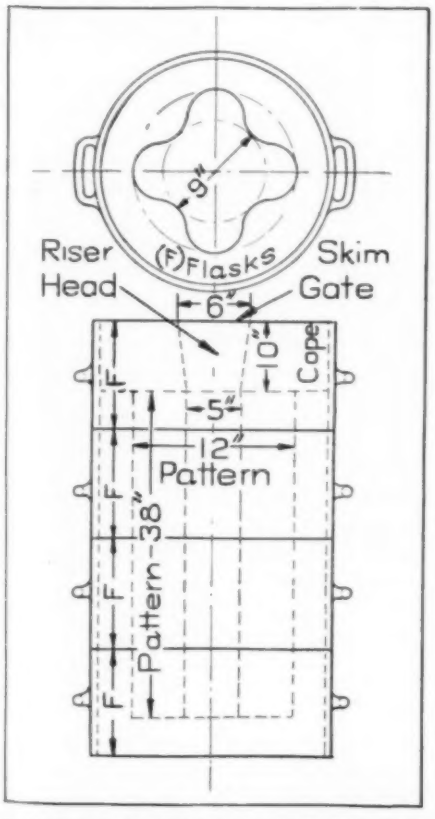


FIG. 1—PLAN AND LONGITUDINAL SECTION OF ASSEMBLED MOLD

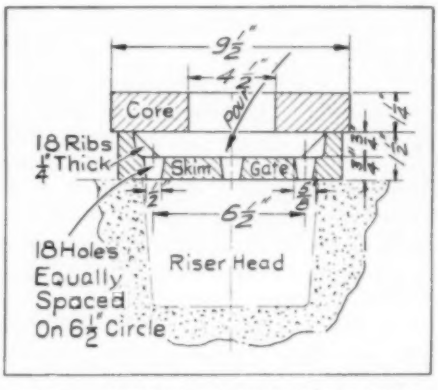


FIG. 2—DETAIL OF SKIMMER BASIN

Spindles molded on their side in green sand are prone to swell out of shape and entail a considerable amount of cutting, either hand or machine, to reduce them to proper working size. Sometimes a shift in the flask leaves the edges of the casting over-lapping to an extent that renders the spindle useless. They usually are poured from fairly hard iron and shrinkage cavities and porosity develop notwithstanding apparently adequate feeding. In this particular instance the coupling box was a sliding fit the entire length of the spindle, and therefore any riser placed at any point along this surface had to be chipped off clean and smooth.

The foundryman quietly ignored the pattern construction and avoided subsequent trouble by nailing the two halves of the pattern together. He made the mold on end in dry sand in the manner shown in the illustration. A feeding head was placed on the top and after the casting was shaken out this head was nicked around and then knocked off with a sledge hammer. The detail of a skimmer basin through which the iron was poured directly into the sink head is shown in Fig. 2. It is made up of two dry sand cores, the lower provided with a number of 5/8-inch holes.

Drop Ball to Knock Off Feeding Risers

By J. O. Proctor

One of the cost items peculiar to steel foundries is that involved in removing the many heavy feeding heads placed at various points on the casting to prevent it from shrinking. Usually they are removed either by sawing or burning. A little extra care in the foundry and closer supervision on the part of the molding foreman will cut down the time and labor required on this part of the work. For instance, consider the ordinary 2½-ton engine frame which comes into the cleaning room with six or eight heads each 6 x 8 x 16 inches. If these heads are carried down straight and full size to the casting, it will be necessary to saw or burn them off, whereas if they are attached to the casting by a pad and neck they may be knocked off by a swinging ball on the crane in a fraction of the time required to remove them in any other manner.

On a basis of comparative costs, with a saw man paid 25 cents an hour, a crane man 30 cents, a chain man 22½ cents and allowing ½ hour for sawing each head

and 10 minute service on each set up, it will cost $1.27½ to saw six heads, or 21.25 cents for each head, plus the wear and tear on the machinery. Where the heads are joined to the casting by a pad and neck the frames can be set up on edge, say 12 in a row and with three or four rows, depending on the available space. Two men at 20 cents an hour can nick the heads from corner to corner on 12 frames an hour, or a total of 72 heads and the craneman can knock them all off in an hour. Of course the chain man has to be taught how to adjust the ball and the craneman instructed how to manipulate his racking gear. On this basis the cost of knocking off the 72 heads would only amount to 92½ cents, distributed as follows: chaneman 30 cents, chain man 22½ cents, two laborers 20 cents each, 40 cents. Removing 72 heads by the saw method costs 72 x 12.25 cents=$15.30, showing a difference in the two methods of $15.30—$0.92½=$14.37½.

Core Print Gives Rigidity to Pattern

By F. C. Edwards

One of the commonest causes of scrap is the failure of the pattern either as a whole or in some part to retain its shape while being molded. In some such cases it is proper to place the blame on the pattern-

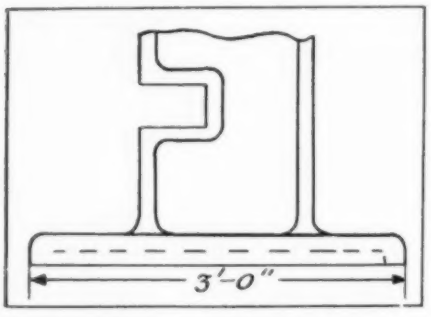


FIG. 1—A FACING STRIP 1 INCH WIDE EXTENDED ALL AROUND THE BASE

maker, who, unless he has had actual molding experience, will be apt to underestimate, if he does not entirely overlook, the force of the rammer and the resulting sand pressure against the pattern. However, there are times when the molder should be held responsible if the methods he adopts are glaringly unsuitable for the particular job in question, or if he expressly desires the pattern to be made without the necessary safeguards from the patternmaker's point of view.

Naturally the foundryman does not always realize as clearly as the patternmaker that the strength of a piece

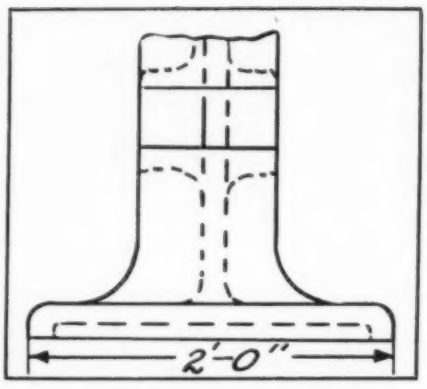


FIG. 2—END ELEVATION

of wood varies with the direction of the grain; and that, in some instances, it is a practical impossibility to prevent the distortion of a pattern, even with the kindliest treatment in the foundry, without extraneous support in the way of brackets, etc., which have to be afterwards stopped off in the mold. Core prints also may be employed to stiffen the pattern.

A typical example of this class of work, lacking in self-support, is shown in Figs. 1 and 2, which give side and end elevations respectively of the lower portion of a rather tall standard provided with a particularly large rectangular base designed to give stability.

The thickness of the base was 1 inch with a ⅜ inch facing strip 1 inch wide around the bottom side.

The pattern was made as shown in Fig. 3, which is an end view as molded. The top half of the flange was loose on joint *A*, and the stout points *BB*, with the grain at right angles to that of the flange, secured a double advantage. They stiffened up the thin flange of the pattern, thus obviating the risk of warping, and at the same time provided a good bearing surface that rendered the well-dowelled loose piece practically immune from the possibility of ramming over. This method, excellent

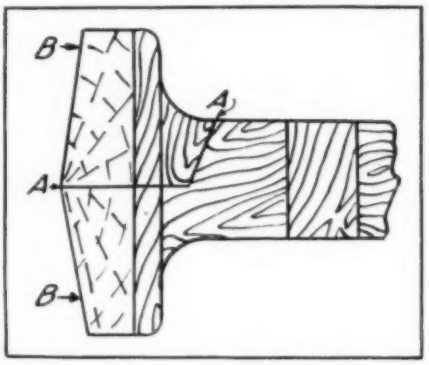


FIG. 3—AN EXTENSIVE CORE PRINT AT THE BACK SERVED TO STIFFEN THE FLANGE BUT PRESENTED DIFFICULTIES IN SETTING THE CORES

in other respects, contains one serious drawback from the foundry point of view; the top half core has to be carried in the cope.

After one casting had been made, which turned out quite satisfactory, the core prints were removed to eliminate this objection and the facing strips at top and bottom were wired on loosely. The next three castings were rejected because in each case the bottom flange was found to be about ½ inch out of square.

It was scarcely to be expected that the foundry would return to the original method after having discarded it, so that the only alternative was to add two strong brackets as shown in Fig. 4. These were firmly screwed to the top flange, thus affording a broad bearing. The brackets had to be stopped out later after the withdrawal of the pattern.

Blower Equipment Needed For Small Cupola

Question: In one of the back numbers of THE FOUNDRY I read an interesting description of a small cupola made from a pair of empty oil drums. All the details of erection and operation were described with the exception of the blower. I should like to know the size of the blower, the horsepower of the motor, and the speed of the motor.

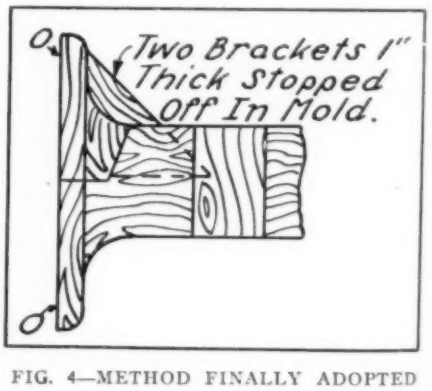


FIG. 4—METHOD FINALLY ADOPTED

Answer: The article to which you refer was submitted by a contributor whose address we have not at the present time. However, for your information it may be stated that a cupola lined to 23 inches has a melting capacity of between 1 and 1½ tons per hour. To melt 1½ tons of iron requires 45,000 cubic feet of air and this divided by 60 gives 750 feet, the amount required per minute. In a general manner it may be stated that a small fan running at 4000 revolutions a minute and driven by a 3-horsepower motor will deliver the necessary amount of air. Motors are manufactured to run at various speeds from 500 to 1000 revolutions per minute.

Correcting Flaws in Metal Mixtures

Problems of the Gray Iron, Malleable and Steel Foundry Discussed

By H. E. Diller

Melting Small Charges

Question: We are contemplating the installation of a cupola in a foundry melting a minimum of 2500 pounds of metal and a maximum of 8000 pounds with an average of 4000 pounds. What size cupola should we install and what ought our melting costs be?

Answer: We would prefer to give you general information from which you can draw your own conclusions, guided by your local conditions. A smaller cupola will use the less coke per ton of iron melted as a smaller bed of coke will be required. Thus, a cupola lined to 27 inches in diameter will melt under the best conditions, 2 tons of iron per hour, and melt your maximum heat in slightly over 2 hours. A cupola 37 inches inside diameter will melt nearly 6 tons per hour, thus finishing your maximum heat in less than an hour. The coke in the bed is in direct proportion to the area of the cupola. Thus, a 37,-inch cupola will take 90 per cent more coke on the bed than a 27-inch cupola. This saving of coke would be secured at the expense of longer melting time. Another saving in securing the smaller cupola would be the first cost of the cupola and the blower.

We would suggest that you do not attempt to keep your melting cost low at the expense of the amount of coke used between the charges, but that you consider primarily the object of securing good hot iron. The bed should be high enough so that the first iron comes from the cupola 8 to 10 minutes after the blast is on. The amount of coke between charges should be 1 to 8 or even as high as 1 to 11, but this should be determined by the temperature of your metal from the cupola.

High Sulphur Iron Resists Oxidation

Question—We manufacture furnace castings exclusively and would like to secure the most up-to-date information in regard to the best iron for grate bars.

Answer—Many stove foundries use the same mixture for grate bars as they do for the stoves. To improve this mixture the silicon is lowered, and the phosphorus is kept around 0.2 per cent. A special iron to resist oxidization can be made by raising the sulphur contents, about 0.25 per cent sulphur being a good proportion. The silicon should be lowered so as to secure the iron as hard as is consistent with the design of the grate bar. By making a high-sulphur white iron you would get the best results to withstand the burning action but the iron might be too brittle.

Manganese in Gray Iron

Question: I know the allowable limits for the elements in gray-iron for different castings with the exception of manganese. How is the amount of manganese to be used determined?

Answer: Manganese is not kept in as close limits as some of the other elements in iron. It should be at least over 0.5 per cent, preferably around 0.6 per cent for the general run of castings. However, for semisteel, manganese is sometimes raised as high as 1 per cent. Care should be taken to see that the manganese is five times the amount of sulphur in the iron as these two elements form a compound, manganese sulphide, and there should be more than enough manganese to combine with the sulphur. After you decide on the amount of manganese you want in your casting you must add a mixture which contains manganese approximately 0.2 per cent higher.

Mixture for Mine Car Chilled Wheels

Question: Kindly furnish us with information as to the proper mixture of iron for making chilled mine-car wheels. At present we are using 60 per cent old car wheel scrap and 40 per cent No. 2 pig iron.

Answer: Chilled mine-car wheels usually are made from a mixture of approximately 60 per cent pig iron and 40 per cent sprue and scrap from the same mixture. The pig iron is such that the mixture will give a casting of to 0.85 per cent; sulphur, under 0.10 per cent; phosphorus, between 0.2 and 0.4 per cent, and manganese between the following composition; Silicon, 0.75 0.6 and 0.8 per cent. Also, many firms use 5 to 10 per cent steel in the mixture. Some use charcoal pig iron entirely, while most of them use some.

Melting Steel Scrap

Question: We have a large amount of light steel scrap and would like to know whether it would be practicable to melt it in the cupola and cast it into pigs as a low-carbon iron.

Answer: It would be impracticable to try to make a low-carbon iron out of light steel scrap by melting it in the cupola owing to the fact that an excessive amount of coke would be required and the steel would take up an irregular amount of carbon. In some cases this would be over 3 per cent. Too, no matter how much coke was used there would be a strong tendency to oxidation and the cupola would be apt to bridge. Also, the resulting iron would not contain any silicon unless this was added in the form of ferrosilicon.

Heavy Scrap Apt To Be Low in Silicon

Question: We are sending you a piece of casting which is hard and brittle, but which was made from iron as we have been mixing it for a number of years without having difficulty. The mixture consists of 60 per cent heavy gray-iron scrap and 40 per cent pig iron containing 2.25 per cent silicon. We think possibly a piece of cold-rolled shafting may have accidentally gotten into the mixture and caused the trouble. Can cold-rolled shafting be used in making semisteel?

Answer: You should have an analysis made of the iron. From its appearance, we judge that the silicon is lower than it should be. This would cause the carbon in the iron to combine and produce a white iron. If you use heavy scrap, you probably got some with low silicon which was gray on account of being poured in a heavy section, while when poured in a light section, it became white iron. Also, some silicon is lost by oxidation during the melting.

Cold-rolled shafting can be used for semisteel mixtures as it is really a low-carbon steel. In using steel in your mixture, you lower the percentage of silicon and, if higher silicon iron is not used, this will have a tendency to harden the resulting casting.

THE FOUNDRY

Registered U. S. Patent Office

A semimonthly journal devoted to all branches of the foundry trade

Published by
THE PENTON PUBLISHING CO., CLEVELAND, O.

BRANCH OFFICES

BOSTON.....426 Old South Bldg.
CHICAGO.....1147 People's Gas Bldg.
CINCINNATI.....504 Edwards Bldg.
NEW YORK.....2203-2206 No. 220 Broadway
PITTSBURGH.....2148-49 Oliver Bldg.
SAN FRANCISCO.....675 Monadnock Bldg.
WASHINGTON, D. C.....84 Home Life Bldg.

FOREIGN OFFICES

BIRMINGHAM, ENGLAND.....Prince's Chambers
LONDON, ENGLAND.2-3 Caxton House, Westminster, S.W. 1
PARIS, FRANCE.....224 Rue de Rivoli
Cable address, IROTRAPEN, London

SUBSCRIPTION

United States and Mexico.....$3.00 a year
Canada.....$4.00 a year
Great Britain and other Foreign Countries.....£1:0:0 a year
Single Copies.....25 cents
Copies published three months or more previous to date of current issue, 50 cents each.

ADVERTISING

All communications relating to advertising copy, discontinuances, etc., must be received on the 1st and 15th of the month preceding date of publication.

Member, the Audit Bureau of Circulations, Associated Business Papers, Inc., and National Publishers Association
Entered at the Post Office at Cleveland as Second Class Matter

Copyright 1923 by The Penton Publishing Co.

Contents

	Page
Castings for Heat Radiation	1
Malleable Foundrymen to Meet in Cleveland	7
States Research Has Been Successful	7
Buys Steel Foundry	7
Seek to Maintain Quality—II	8
Book Review	11
Foundry Problems Are Covered	12
Developing Material for the Foundry	13
Pencil Gates Applied to Friction Disk	14
Engage in Foundry Consulting Practice	14
Plans Test to Define Sands—I	15
Methods of Molding Bushings	19
How and Why in Brass Founding	22
Miscellaneous Scrap Does Not Equal Ingots	22
Aluminum Cuts the Sand	22
Railings Are Dirty and Small Valves Leak	23
Facings Aid in Cleaning Brass Castings	23
Impurities Found in Scrap Valve Castings	23
Alloy to Use With Die Casting Machine	23
Permeability of Malleable High	24
Recalls Castings Seen at Paris Show	25
Foundry Equipment House Issues Bulletin	26
Manufacturers Seek to Improve Refractories	26
Use Duplex Process for Refining Steel	26
Compares Cupola Receivers	27
Bill Questions the Wisdom of Solomon	31
Seacoal Facing Produces Clean Castings	33
Offers Simple Test for Sand	34
Development of Steel Ladle Stoppers	35
Applies Drop Test to Malleable Wedges	36
Rolling Mill Spindles Cast on End	37
Core Print Gives Rigidity to Pattern	38
Correcting Flaws in Metal Mixtures	39
Efficient Melting of Small Charges	39
High Sulphur Iron Resists Oxidation	39
Percentage of Manganese for Gray Iron	39
Mixture for Mine Car Chilled Wheels	39
Melting Steel Scrap	39
Journal Boxes Made of Semisteel	39
He Always Delivers the Goods	40
Trade Outlook in the Foundry Industry	41
Comings and Goings of Foundrymen	42
New England Foundrymen View Films	42
Obituary	43
Philadelphia Equipment Maker Is Dead	43
Slag for Cleaning Castings Disintegrated	43
Gyratory Riddle Works Off Lamp Socket	43
Venturi Tube Burner	44
Develops Crane Brake	44
Closing Weeks Prove Active	45
What the Foundries Are Doing	46
New Trade Publications	46

He Always Delivers the Goods

ONE of the outstanding characteristics of human nature is that which manifests itself in the smug belief that each generation is superior to that which has gone before. This particularly is true when considered in connection with the arts and sciences. In a general way probably this belief is justified, but foundrymen would do well before throwing too many bouquets at themselves to consider some of the outstanding works of the old masters. Along the lines of mass production and scientific control, undoubtedly the foundry industry is on a higher plane than ever before, but in the production of large individual castings, or in the exquisite detail of finish presented in light and fragile castings the men who have gone before established records that in some instances never have been equalled and certainly never have been surpassed. A peculiar feature of this subject is that the most beautiful examples of artistic castings in the museums of America were executed in the Ural district of Russia by a people popularly regarded in our superior occidental minds as at best only semi-civilized. The same holds true in connection with brass castings, as any person who has had an opportunity of examining Japanese works of art can testify.

The largest and heaviest iron casting on record was poured near Odessa in the Russian peninsula of the Crimea about 60 years ago. It was estimated to weigh 600 tons and was poured direct from 48 American made cupolas erected in the immediate vicinity for the purpose. It was designed for an anvil block for the largest steam hammer ever contemplated and the fact that it never was used was due to other engineering difficulties that arose in connection with the project. If it served no other purpose it furnished an outstanding tribute to the skill of the foundryman and another link in the long chain of evidence supporting the claim that the foundryman is willing and competent to meet any and all demands of the engineering profession.

Old time foundrymen may have been crude, uncouth and unlettered according to modern standards, but certainly not more so and probably not to such an extent as their contemporaries in any other branch of engineering at any given period. The application of the steam engine was delayed for many years after its successful inception, not through inability of the foundryman to produce the necessary castings, but because no machine tools were available to finish them accurately to dimension. Not a single one of the cylinders of James Watt's pumping engines was bored straight or truly round. He complained often and bitterly of their lack of efficiency due to the fact that it was impossible to secure a tight fit for his pistons. In addition to not being straight in the bore the right angle axes of the cylinders varied at times to the extent of ½-inch.

In recent years the introduction of the automobile furnished additional testimony to the mechanical skill, metallurgical knowledge, ingenuity and resourcefulness of the foundryman in successfully meeting the most stringent specifications and intricacy of design imposed by designing engineers. The foundryman may not be a shining light in the generally accepted meaning of the term; he may not be in the front rank when the medals are distributed, but he has one outstanding qualification that deserves consideration—he always delivers the goods.

Trade Outlook in the Foundry Industry

NORMAL holiday pause is the term applied to the slackening off during the closing weeks of December in practically all lines of foundry activity, but more particularly in the automotive and malleable branches. Whatever the explanation, the fact remains that foundry operations have been lighter during the last few weeks of the year. Similarly, the purchases of fuel and metal have not been as extensive, nor has the inquiry been as active as in the period immediately preceding Dec. 15. Probably 60 per cent of the iron foundries have placed contracts for pig iron covering the first quarter.

Clean Slate To Start

A great number of smaller foundries and jobbing shops are numbered among the 40 per cent or more who have not purchased iron for the first three months of 1923. This percentage is enormously increased when a count is made of those which have ordered iron for the entire first half of the year. Furnaces and customers alike have been reluctant to go beyond the first three months; many ascribing their attitude to distrust of the conditions should another coal strike confront the country in the spring. With the greatly increased melt during the closing months of the year, naturally a greater tonnage of iron has been purchased; but few foundries have acquired a stock sufficient to last beyond a few weeks. This condition likewise prevails in the yards of many pig iron producers, where the demand has increased with as great rapidity as has the consumption of the output. Basing their belief upon these factors, strengthening prices are predicted by a great number of those in daily touch with the market. Coke prices, too, are slightly higher, but deliveries continue good.

Prices of Raw Material for Foundry Use

CORRECTED TO DEC. 26

Iron		Scrap	
No. 2 Foundry, Valley	$26.00 to 27.00	Heavy melting steel, Valley	$20.75 to 21.25
No. 2 Southern, Birmingham	23.00 to 25.00	Heavy melting steel, Pitts	20.50 to 21.00
No. 2 Foundry, Chicago	28.00 to 28.50	Heavy melting steel, Chicago	17.25 to17.75
No. 2 Foundry, Philadelphia	28.00 to 29.50	Stove plate, Chicago	18.50 to 19.00
No. 2 Foundry, Buffalo	26.00 to 27.00	No. 1 cast, Chicago	22.75 to 23.25
Basic, Valley	24.50 to 25.00	No. 1 cast, Philadelphia	20.00 to 21.00
Basic, Buffalo	26.00	No. 1 cast, Birmingham	20.00 to 21.00
Malleable, Chicago	28.00 to 28.50	No. 1 cast, Buffalo	21.00 to 22.00
Malleable, Buffalo	26.00	Car wheels, iron, Pittsburgh	21.50 to 22.00
Coke		Car wheels, iron, Chicago	23.50 to 24.00
Connellsville foundry, coke	$8.50 to 9.00	Railroad malleable, Chicago	23.00 to 24.00
Wise county foundry, coke	8.00 to 8.50	Agricultural mal., Chicago	23.00 to 24.00
		Railroad malleable, Buffalo	20.00 to 21.00

Labor Less Plentiful

With the improvement in operating conditions through the fall and early winter, the number of workmen employed has increased steadily. According to the department of labor, October showed an increase over September of 5.1 per cent in the number of men employed in the foundry and machine shop field. In November another increase of 4.7 per cent is marked. The available supply of labor has been dwindling in many centers, and a shifting and efforts to entice men from one territory to another have been noted during December. Pattern makers and molders alike have been in demand, notably in some foundry centers in Michigan where the stove and automobile industries have been active and castings demand has been strong. In Ohio, according to statistics compiled by the Ohio State Foundrymen's association, foundry operations increased from 61.4 per cent in October to 63.3 per cent in November. Stove and furnace foundries have continued to maintain a high scale of production, as have most of the jobbing shops, particularly those handling light and medium gray-iron work. Malleable production dropped off slightly in December, more strongly toward the close; but an increase is expected in January. Automotive shops with a few notable exceptions were practically idle during the last two weeks of the year; but the opportunity was appreciated to put equipment in shape for 1923 production.

Finished Strong

Two leaders among the industries which utilized a large tonnage of castings achieved high records for the year just past and both are transportation agencies. According to *Automotive Industries*, automobile production in November passed the 200,000 mark, bringing the probable total for the year to 2,500,000 passenger automobiles and trucks. Early schedules for the new year promise a continuation of the high rate of production. The other industry mentioned, is the railroads, which collectively constitute a large customer for castings both for new work and for repairs. Although buying dropped away during the last few weeks of the year 1922, *Railway Age* states that the orders for freight cars placed during the first 11 months of the year totaled higher than any previous 12-month period since 1916. A total of 139,257 freight cars were ordered up to Dec. 1 and this, compared to the 1921 total of 23,346 demonstrates the great increase. The total shown for November was slightly less than that for the previous month, but a high average was maintained. Locomotive purchases, too, have been large for the past year, while inquiries indicate further buying early in 1923. Large inquiries for new cars are also extant, one statement showing over 45,000 cars on inquiry before Chicago and western car builders at the close of the year. Implement manufacturers are placing contracts for castings.

Brass Shops Active

Plumbing goods brass foundries are operating at a fair rate and activity is increasing among other lines of nonferrous castings manufacture. Prices on nonferrous metals, based on New York quotations in the *Daily Metal Trade* of Dec. 26, follows: Casting copper, 14.25c; electrolytic copper, 14.62½c; lead, 7.25c; Straits tin, 38.62½c; antimony, 6.30c to 6.35c; aluminum, No. 12 alloy, producers' price, 23.50c to 23.70c and open market, 20.50c to 21.50c. Zinc is 7.00c, E. St. Louis, Ill.

Comings and Goings of Foundrymen

FRANK J. McGRAIL has been appointed general superintendent of foundries for the Westinghouse Air Brake Co., Wilmerding, Pa., to succeed Samuel D. Sleeth who retired December 5 on his 70th birthday after nearly 60 years active and continuous service in the foundry. Mr. McGrail was born in Providence, R. I., December 11, 1876, and after a grammar school course, afterward supplemented by an evening high school course, he enterd the shops of the George H. Corliss Engine Co., Providence, R. I., where he served a 7-year apprenticeship in the machine shop, pattern shop and foundry in the manner prescribed by the company. After nine years of practical foundry experience as a journeyman molder, an experience that embraced every section of the United States and several European countries, he was appointed general foreman of the Worthington Pump Co.'s foundry, Harrison, N. J., a connection that lasted for three years. Since that time he has been successively foundry superintendent with the Erie Foundry Co., Erie, Pa., Gleason Works, Rochester, N. Y., Struthers-Wells Co., Warren, Pa., and for nearly three years with the Honolulu Iron Works Co., Honolulu, T. H., before assuming his present connection. Mr. McGrail is a member of the American Foundrymen's association and the American Society of Mechanical Engineers.

Robert La Point has been made superintendent of the Chas. H. Stehling Co. foundry, Cedarburg, Wis.

H. P. Kreulen, Bethlehem Steel Co., addressed a meeting of the Wisconsin Foundrymen's association at the Hotel Pfister, Monday, Nov. 28. William J. Grede is president of the association.

Jack Robinson has been made superintendent for the A. E. Martin Foundry Co., Milwaukee. Mr. Robinson formerly was associated with the Waterloo Gas Engine Co., Waterloo, Iowa.

F. B. Sweet, who for the past seven years has been superintendent of the foundry department for the Saco-Lowell Shops, Lowell, Mass., has been made superintendent of the Vulcan Foundry Co., Ambler, Pa.

E. R. Ritter has been made secretary-treasurer in charge of manufacture for the Cincinnati Aluminum Casting Co., Cincinnati. Mr. Ritter formerly was president of the Hill & Griffith Co., Cincinnati, producer of foundry supplies, and previous to that time was superintendent for the Lunkenheimer Co., of that city.

The Foundry 1922 Index

THE complete listing of all articles published during 1922, with cross references and an authors' index has been prepared and is now ready for distribution. This will be sent free to any subscriber who makes request for a copy to the Circulation Department, THE FOUNDRY, *Cleveland.*

Herbert M. Ramp has been made superintendent of foundries for the

FRANK J. McGRAIL

Advance-Rumely Co. at its plant in LaPorte, Ind. Mr. Ramp was superintendent of foundries for the American Locomotive Co., Dunkirk, N. Y., during the past five years.

Ernest C. Jarvis has resigned his position as superintendent of foundries and rolling mills for the McNab & Harlan Mfg. Co., Patterson, N. J., effective Jan. 1. Mr. Jarvis expects to sail Jan. 15 for a cruise covering ports of South and Central America. On his return, he will engage in consulting metallurgical engineering practice.

M. W. Zeman of Paris, general European director of the Osborn Mfg. Co., Cleveland, sailed for the United States on the MAJESTIC Dec. 6. Mr. Zeman expects to remain in the United States until spring. He states that the foundry equipment business in France and Belgium is somewhat better but that American exporters are handicapped by the weakness of the franc.

Grant Hubley, vice president in charge of sales of the Oil Well Supply Co., Pittsburgh and Oil City, Pa., has been promoted to the position of vice president and general manager of the company to succeed the late Louis C. Sands. D. J. Brown, treasurer, succeeds Mr. Hubley as vice president in charge of sales; S. Clarke Reed, secretary, is elected vice president in charge of branch stores; H. C. Burns, credit manager, succeeds Mr. Brown as treasurer, and J. F. Hunter succeeds Mr. Reed as secretary. Thomas Fleming Jr. is vice president in charge of production, and H. A. Boschert is assistant treasurer.

New England Foundrymen View Films

A film showing the process of making centrifugal cast iron pipe furnished the chief entertainment at the regular December meeting of the New England Foundrymen's association which was held Dec. 13 at the Boston Athletic club. The film shows in unusual detail the complete centrifugal molding practice of the United States Cast Iron Pipe Co., Burlington, N. J. Several other industrial films also were shown. One, called the "Conquest of the Forest," a complete story of the manufacture of lumber, emphasized the use of modern machinery, especially electrically driven machinery. This film was presented by the General Electric Co., Schenectady, N. Y. The president, E. H. Ballard, appointed the nominating committee to make nominations for officers for 1923. Election of the officers will take place at the January meeting.

Hold December Meeting

The fourth meeting of the Quad City Foundrymen's association was held in the Chamber of Commerce in Moline, Dec. 18. Frank D. Chase, foundry engineer, Chicago, delivered an illustrated address on foundry design and construction. Further growth of the association is sought through

the appointment of a membership committee comprising: P. T. Bancroft, East Moline, chairman; William Seiffert, Moline; Roy Schofer, Rock Island; A. K. Reading, Davenport; R. L. Eichman, Bettendorf.

Other committees appointed include a fellowship committee made up of the following: E. H. Heartlein, chairman; A. C. Howard; Leon Mitchell; Dave Kennedy. The interest of the association in employment problems is evidenced in a new committee on apprenticeship which includes the following: F. W. Kirby, chairman; E. A. Gullburg; H. E. Alex; C. E. White; Carl E. Shields.

Obituary

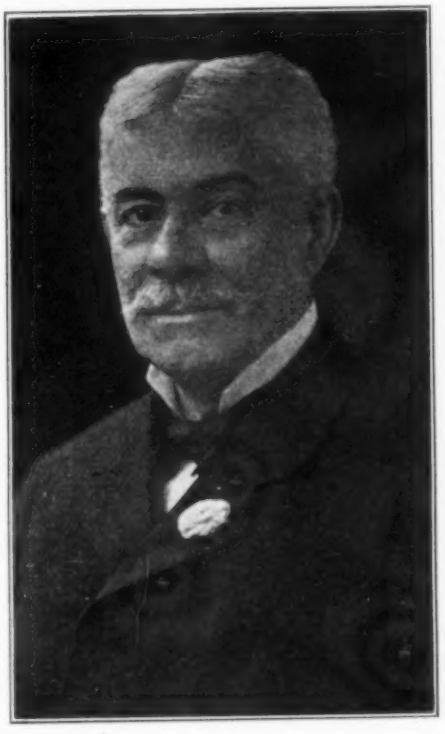
Samuel Reed, for many years associated with the Love Brothers, Aurora, Ill., as manager of their Aurora foundry, died the forepart of November.

Fred A. Marsh, general purchasing agent, Link-Belt Co., Chicago, died suddenly at his home, 6436 Greenwood Ave., Chicago, Dec. 11, aged 52 years. Mr. Marsh had been affiliated with the Link-Belt Co. for over 33 years. He was an organizer of the Purchasing Agents association of Chicago, was its first president and for some years was a director of the National Association of Purchasing Agents.

Florence McCarthy, one of the pioneer malleable foundrymen of the west died on October 12 at his home on Ashland boulevard, Chicago. He was born in Ireland on December 25, 1844 and came with his parents and one brother William H., to the United States in 1855. The family settled in Naugatuck, Conn., where the boy at the age of 13 began working occasionally in the malleable foundry of Tuttle & Whittemore. At 15 he was employed regularly as a coremaker and afterward served as molder, patternmaker and melter. He eventually became assistant superintendent and in 1874 was transferred to Chicago to take charge of the foundry of the Chicago Malleable Iron Co. in which Tuttle & Whittemore were then interested. Mr. McCarthy continued as foundry superintendent of the Chicago Malleable Iron Co., and subsequently of the National Malleable Castings Co., at Chicago until the death of his son Florence in 1909, when he retired from active work. In 1873 he married Miss Maria Butler of Naugatuck, Conn., and of the nine children born to the union six survive, William F., Alexander J., George H., and Lillian of Chicago, Mrs. H. F. Maginn, Butte, Mont., and Mrs. H. J. McNicholls, St. Louis. Mrs. McCarthy died in 1921.

Philadelphia Equipment Maker Is Dead

Joseph S. Hibbs, veteran manufacturer of foundry supplies and equipment, died of pneumonia on Dec. 8 while on a visit to his daughter Mrs. George W. Bahlinger, Trenton, N. J. He was 79 years old and for 30 years had been a member of the firm of J. W. Paxson Co., Philadelphia. Mr. Hibbs learned the trade of stove molding with the Liebrandt & McDowell Stove Co., Philadelphia and had attained to the position of foundry foreman when he enlisted in the Union army in 1862 and served throughout the duration of the civil war. Upon



JOHN H. HIBBS

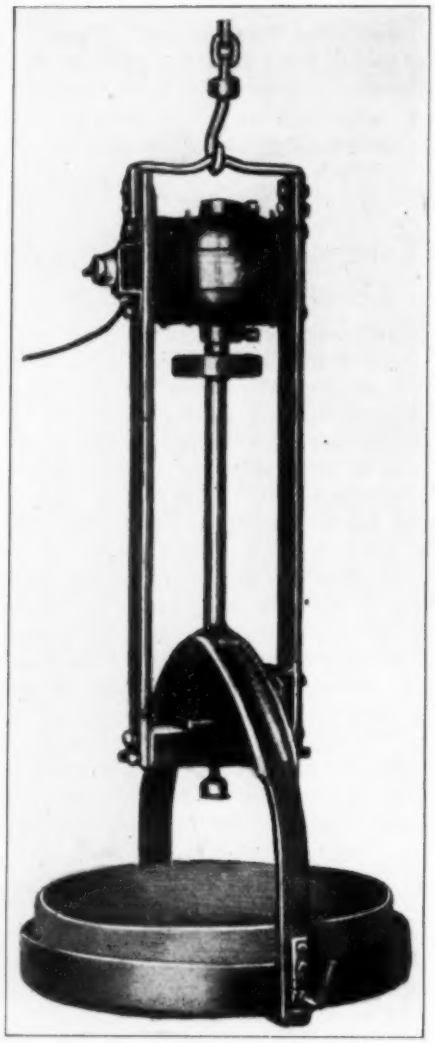
his discharge from the army he returned to Philadelphia and entered the foundry business on his own account. Later he accepted a position as sales manager for the S. Obermayer Co., at Cincinnati and afterward had charge of the Chicago office of the same company. At one time he served as foreman for the George B. Ives Foundry Co., Montreal. Thirty years ago he joined the J. W. Paxson Co., Philadelphia, as salesman and assistant general manager in direct charge of the traffic department. The late Mr. Hibbs was a member of the Manufacturers' Club, American and Philadelphia Foundrymen's associations, American Society of Mechanical Engineers, American Institute of Mining and Metallurgical Engineers, American Ceramic society, Traffic Managers association, American Academy of Political and Social Science, Pennsylvania Museum and School of Industrial Art, and the Pennsylvania Academy of Fine Arts. He is survived by one daughter, Mrs. George W. Bahlinger, Trenton, N. J., and one son, Frank C. Hibbs, Philadelphia.

Disintegrates Slag for Cleaning Castings

Application of slag to cleaning castings in a tumbling mill and at the same time recovering particles of iron contained in the slag together with portions of the slag in condition to use as an abrasive in sandblasting, is accomplished by a process for which patent application has been made by the inventor, H. R. Culp, Reading, Pa. Of course it is well known that in the past slag has been used in tumbling mills, but it is claimed by Mr. Culp that the previous process has never successfully cleaned the castings nor has the recovery of the metallic particles of the slag been satisfactory. In his method, dry slag is crushed in a tumbling mill, using a few pigs of iron. This is done to obtain a quantity of small irregular pieces of iron freed from the slag, sand and dirt which are drawn off by the exhaust. The dust is carried to the arrester and the heavier sand, silicates, and fine particles of iron are deposited in the trap at the base of the dust arrester. A quantity of the recovered iron equal to the amount of jack stars generally used are left in the mill and castings are placed in the barrel together with approximately a half dozen shovelfuls of slag and the milling continued until the castings are clean. During the milling, the slag will be disposed of as already described. The particles caught in the trap can be used for sandblasting. In case no exhaust is used the slag as it is crushed falls out between the staves. The process is now in operation at the foundry of the Temple Malleable Iron & Steel Co., Temple, Pa., near Reading, and at several other malleable iron foundries.

Gyratory Riddle Works Off Lamp Socket

Equipped with a 1/3-horse power General Electric motor, either direct or alternating current, 110 or 220 volt, a gyratory type riddling device which can be suspended from any convenient support, recently has been placed on the market by the Lowe Manufacturing Co., 6063 Wabash Ave., Detroit. A parallel ball bearing eccentric operated by the armature of the motor causes the sifter shaft to gyrate at its upper end. The sifter bracket is attached to this end directly



NEW DESIGN GYRATORY RIDDLE

above a ball and socket bearing, assuring a steady motion during 1724 gyrations a minute. The riddle is held in the ring by a hand set screw permitting of easy and rapid change from one size to another and is suspended in such a manner that the shoveler has free access practically all round it. It is claimed that the device has a capacity of one ton of oil sand through a No. 4 riddle in 3½ minutes or a ton of floor sand through a No. 2 18-inch wood rim riddle in 4 minutes.

Venturi Tube Burner

Utilization of the venturi tube principle is presented in a new type of fuel oil atomizer manufactured by the Hauck Manufacturing Co., Brooklyn. From the sectional view shown in the accompanying illustration it will be noted that the burner consists essentially of a cylindrical casing containing a central bore closed at the outer end and provided on the periphery with slots parallel to the axis of the bore. These slots, with the inner wall of the casing, form longitudinal ports through which the atomized oil is driven into the furnace. Each port is a small venturi tube constricted at the center and flared out at the two ends. The constricted parts of the openings are connected with the interior of the bore through radial apertures.

The fuel, which may take the form of any fuel oil or even tar, is delivered to the bore under a pressure of 40 to 60 pounds and forced through the radial openings against the incoming air or steam, depending on which agent is employed as an atomizer. The compressed air or steam is delivered to the burner at a pressure

SHOWING APPLICATION OF VENTURI TUBE PRINCIPLE ON AN OIL BURNER

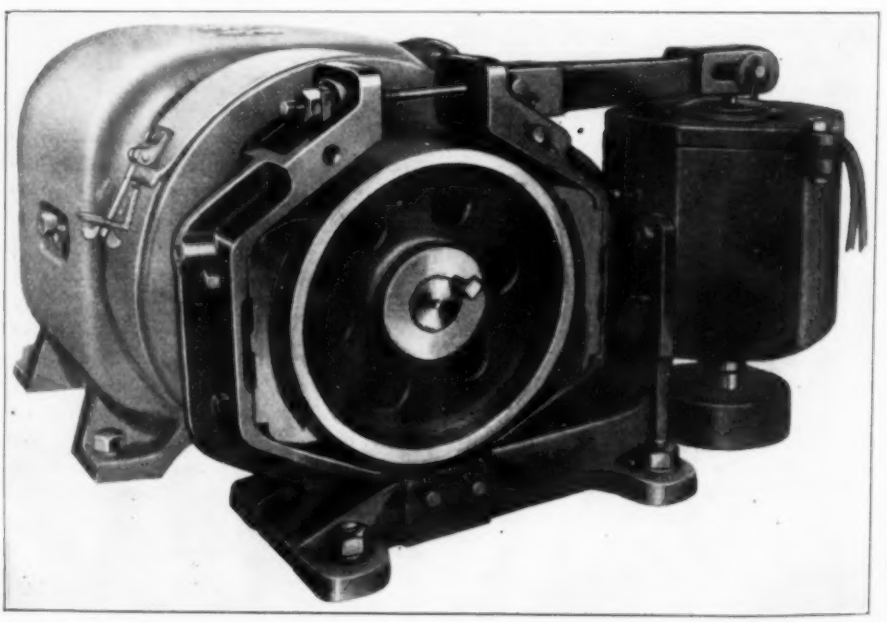
that may vary from 30 to 100 pounds. The velocity increases as it flows through the ports and reaches its maximum at the constricted point in each opening. Here it blasts the fuel, atomizes drives it through the burner.

Develops Crane Brake

Among the advantages claimed for the brake shown in the accompanying illustration are quick action, interchangeable parts, ease of adjustment, rugged construction. The device has been developed by the Whiting Corp., Harvey, Ill., and was subjected to a series of exhaustive tests in the plant of that company before it was placed on the market. For example a 12-inch brake was mounted on a 25-horsepower, 550-revolutions per minute, direct current motor and although the motor was stopped 50,000 times at a rate of 325 stops per hour, it is stated that the brake showed no sign of wear beyond the usual shoe abrasion. In testing out a number of different lining materials the one finally selected was not affected when operating with the brake wheel at a dull red heat. The average wear indicated 0.0005 inch per 1000 stops with the motor running at 1800 revolutions per minute.

The brake arms are so pivoted that the shoes release equally at all points and naturally when the brake is applied the shoes bear equally at all points, resulting in quick action and uniform wear. Brake wheels and shoes are interchangeable with like parts on the standard foot brake made by the Whiting Corp. Under ordinary conditions shoe adjustment is only necessary once a month and then it is accomplished easily by removing four cap screws and sliding the shoes out.

A. S. Kinsey, professor of shop practice, Stevens Institute of Technology, Hoboken, N. J., addressed a meeting of the Philadelphia Foundrymen's association held Dec. 13, on the manufacture of oxygen and acetylene gas and the use of gas flame in cutting metals.



THE BRAKE ARMS ARE SO PIVOTED THAT THE SHOES EITHER RELEASE OR BEAR EQUALLY OVER THEIR ENTIRE SURFACE

Closing Weeks Prove Active

Foundry Equipment Inquiry Is Brisk, Pointing to Increased Buying in the Early Months of the New Year—Sand Blast Machinery Sales Are Heavy—Export Inquiry Noted

NINETEEN twenty-three will be greeted with interest and confidence by foundry equipment manufacturers. The closing weeks of the old year found such an increase in volume of inquiry and sales that the most cheerful outlook is presented. Among the sales of interest were a number involving the export of American foundry machinery. Recent purchasers of induction furnaces from the Ajax Electrothermic Corp., Trenton, N. J., include Johnson Matthey & Co., Ltd., and the National Physical Laboratory in England; and the Western Electric Co., Chicago; the General Electric Co., Schenectady, the Mellon Institute of Industrial Research, Pittsburgh and the Bureau of Mines Station, Columbus, O. Sobrinos de Portilla, San Juan, P. R., is inquiring for crane equipped cars to lift and transport some 20,000 tons of 24 and 30-inch cast iron pipe for a new aqueduct and also is interested in a pressure testing machine capable of handling pipe of the sizes noted F. J. Ryan & Co., Philadelphia, have a contract to install a gas-fired annealing furnace at the plant of the National Cast Iron Pipe Co., Birmingham, Ala. The Chicago Iron Foundry Co., Chicago has let a contract for an addition, 100 x 100 feet which will give space for 60 more molders. P. McGuire is vice president and manager. The F. A. Coleman Co., Cleveland, recently has sold two roller-drawer ovens to the Johnson Bronze Co., New Castle, Pa. Peacock Brothers, Ltd., 179 Delorimier avenue, Montreal, are in the market for new or used sand blast equipment capable of handling work up to 18 x 36 inches in size. Recent sales by the Pangborn Corp., Hagerstown, Md., include installations for the Detroit Stove Works, Detroit; Everett Steel Co., Everett, Wash., the Portsmouth Stove & Range Co., Portsmouth, O.; and Campbell, Wyant & Cannon Foundry Co., Muskegon, Mich. W. Mayor, Cleveland, is installing six furnaces to supply heat to core ovens at the plant of J. B. Clow & Sons, Coshocton, O., and also is installing seven furnaces for drying molds at the same plant.

Eastern Outlook Bright

NOTWITHSTANDING the holidays, a fairly good amount of business has been done the past two weeks in foundry equipment. One large seller states that December taken as a whole was the best in many months, and that the outlook for business upon the termination of the inventory season is most encouraging. An encouraging feature at this time is the marked improvement in foundry operations. Indicative of this growing activity are several contemplated projects, which will have an even more direct bearing on equipment buying. One is a new plant at Norfolk, Va., for the American Brakeshoe & Foundry Co., which recently disposed of its plant in Newark. Plans have not been completed as yet, but a site of 17 acres has been purchased. Other contemplated construction includes an addition for the North American Foundry Corp., Chester, Pa.; a foundry for the C. B. Bohn Co., Detroit, and an extension said to include additional foundry space for Jenkins Bros., Bridgeport, Conn., manufacturers of valves and fittings. Recent orders include a 10-ton helical geared ladle for the Farrell Foundry & Machine Co., Ansonia, Conn.; a tumbling barrel for the Salem, O., plant of the E. W. Bliss Co.; and a 7-ton bottom poured geared crane ladle for the American Locomotive Co., all going to the Whiting Corp., Harvey, Ill. The American Locomotive Co. also has closed on some other foundry equipment, principally for its Schenectady, N. Y., plant. The Magnus Co., Jersey City, has purchased a sand mixer from the Royer Foundry & Machine Co., Wilkes Barre, Pa.; the Bayonne Steel Castings Co., which is being reorganized as the Eastern Steel Castings Co. has purchased a mixer from the National Engineering Co., Chicago, and is to come into the market shortly for additional equipment, including overhead cranes. This equipment will all be installed in its Newark, N. J. plant. Another buyer is the Bartlett Hayward Co., which continues to close on equipment for its new plant addition in Baltimore. Among its latest purchases are a loader and a mixer. A likely buyer in the near future is the Morristown Electric Steel Castings Co., Morristown, N. J., which is contemplating extending its plant facilities considerably. The Weir Stove Co., Taunton, Mass., has purchased sand blast equipment from the Hagerstown, Md.

Early Inquiry Rife in Pittsburgh

PROMISE of considerable buying early in 1923 is held out to foundry equipment sellers in the Pittsburgh district in the tangible form of numerous inquiries for small lots, together with several for larger installations. One or two complete layouts are in the air as are several replacements, together with a number of additions to present equipment inventories. The Blackwood Electric Steel Co., Parkersburg, W. Va., is believed to have already made arrangements for equipment. The several foundries which suffered fires recently are inquiring for and making purchases of equipment, mainly for pattern shops. These include the Monessen Foundry & Machine Co., Monessen, Pa.; the Duquesne Steel Foundry Co., Coraopolis, Pa., and the Velte Foundry & Machine Co., Mars, Pa. The National Radiator Co., Johnstown, Pa., is reported to be contemplating purchases for its New Castle, Pa. plant and the Rabe Pipe & Foundry Co., Chattanooga, Tenn., also is expanding. Several inquiries have been received here for pyrometers from malleable foundries and one or two inquiries are out for ladle driers from gray iron foundries. Small inquiries are coming in thick and fast for supplies and small equipment such as lathes, flasks, riddles, etc. Two or three sand mixing outfits are up for consideration as are one or two cupolas, core ovens, etc. The Stroh Steel Hardening Process Co., Pittsburgh, closed on a disk grinder. Included in the list of recent flask purchasers is the Dravo Brass & Mfg. Co. Flask business just now appears to be confined to small lots where experimental work is being conducted or where a few are desired for replacements or to add to equipment now in use. No recent purchases of flasks are against larger production. Practically no demand exists for air compressors and sales of wheelbarrows to foundries likewise are light. Recent purchasers of electric furnaces from the Pittsburgh Electric Furnace Corp., Pittsburgh, include the Pittsburgh Valve Foundry & Construction Co., Pittsburgh and the Blackwood Electric Steel Corp., Parkersburg, W. Va. The Westinghouse Electric & Mfg. Co., East Pittsburgh, bought a 5-ton crane for its Homewood plant from the Alliance Machine Co.,

Alliance, O., but so far as reported the Advance Foundry Co., Dayton, O., has not closed on its 15-ton used crane.

Chicago District Projects Construction

ENGINEERS and architects have a number of projects under way and others are being held off until after the first of the year, the promise being for an active season of building and enlargement of existing foundry structures in the coming year. Molding machines are being bought widely in small lots and single machines and a number of larger lots are now going through Chicago shops. An interesting recent sale by the Whiting Corp., Harvey, Ill., is that of a 60-inch cupola for shipment to Paris, France. The Lehigh Coal Co., Philadelphia, has bought a 48-inch cupola from the same maker. The American Steel Foundries has purchased from the Whiting Corp. 25 three-ton yard trucks. Crane sales by this manufacturer include a 5-ton single I-beam, 15-foot span to the LaBelle Iron Works, Wheeling, W. Va.; to the General Electric Co., Schenectady, N. Y., four 2-ton pillar cranes, two 3-ton, one 5-ton and one 8-ton pillar cranes; H. Humphrey & Son., Joliet, Ill., 10-ton electric, 30-foot span. The Maynard lectric Steel Casting Co. and the Sivyer Steel Casting Co., Milwaukee have purchased sand blast equipment from the Pangborn Corp., Hagerstown, Md.

What the Foundries Are Doing

Activities of the Gray Iron, Malleable, Steel and Brass Shops

The plant of the Co-Operative Foundry Co., Rochester, N. Y., recently was damaged by fire.

The Yoder Mfg. Co., Cleveland, is rebuilding its plant which recently was damaged by fire.

The Atlas Foundry & Machine Co., Tacoma, Wash., has increased its capital stock to $82,500.

The North American Foundry Corp., Chester, Pa., plans the erection of an addition.

The Charles B. Bohn Foundry Co., Detroit, is considering the erection of an addition.

Erection of a plant building, 1-story, 75 x 150 feet, is being planned by the Kunkel Valve Co., Ft. Wayne, Ind.

The Michigan Copper & Brass Co., 5851 West Jefferson street, Detroit, plans the erection of a 1-story plant addition.

Erection of a 1-story foundry building is being planned by the M. W. Kellogg Co., Westside avenue, Jersey City, N. J.

Erection of an addition to its plant is being planned by the Machine Steel Casting Co., Alliance, O.

The capital stock of the Ohio Foundry Co., Cleveland, recently was increased from $75,000 to $1,000,000.

The Ohio Refractories Co., Ironton, O., has started work on the rebuilding of its plant which recently was damaged by fire.

The National Radiator Co., Johnstown, Pa., plans the erection of a 1-story foundry building, 30 x 350 feet, at New Castle, Pa.

William Gilbert of Ada, Okla., is negotiating with the Rawline, Wyo., board of trade, regarding the establishment of a foundry in that city.

The Byron Jackson Iron Works, Inc., Berkeley, Cal., announce a change in the name of the firm to the Byron Jackson Pump Mfg. Co., Inc.

The Howard Furnace Co., 881 Yonge street, Toronto, Ont., will be in the market soon for equipment for a new plant.

Jenkins Bros., Bridgeport, Conn., manufacturer of valves and fittings, has let a contract for the erection of an addition to its plant.

The capital stock of the Sloan Valve Co., Chicago, recently was increased from $50,000 to $1,000,000.

The W. F. & John Barnes Co., Rockford, Ill., manufacturer of iron and woodworking machinery, has increased its capital stock from $150,000 to $450,000.

The plant of the Williamson Heater Co., Oakley, Cincinnati, recently was damaged by fire. Two of the four buildings of the plant were affected.

The Mathieu Foundry Co., Benton Harbor, Mich., which was incorporated a few years ago, recently increased its capital stock from $6000 to $100,000.

The Cornell-Baxter Foundry Supply Co., Cleveland, has been incorporated with $5000 capital stock by Clifford B. Cornell, D. L. Cornell, David D. Baxter, H. M. Baxter and John C. Cornell.

The capital stock of the Malleable Iron Range Co., Beaver Dam, Wis., recently was increased from $750,000 to $1,000,000.

The Aluminum Foundry Co., Boston, recently was incorporated with $10,000 capital stock by Harry D. Finberg, and others.

The American Brakeshoe & Foundry Co. is understood to be planning the erection of a new plant at Norfolk, Va. It recently disposed of its plant at Newark, N. J.

Contract has been let by the Adams Pattern & Foundry Co., 6250 South Halsted street, Chicago, for the erection of a foundry building, 24 x 98 feet.

The Wagner Castings Co., Decatur, Ill., has changed its name to the Wagner Malleable Iron Co. and increased its capitalization to $200,000. A. W. Wagner is president of the company.

The plant of the Collinwood Foundry & Mfg. Co., Cleveland, has been purchased by Max Greenhut, president of the L. N. & N. Foundry Co., Cleveland, at a receiver's sale. The plant, which has been closed for about one year, will be reopened under the name of the Collinwood Foundry Co.

The plant of the Brass Products Foundry Co., Providence, R. I., has been moved to larger quarters at Massasoit avenue, Pawtuxet, R. I. It now occupies a building, 60 x 200 feet. The company specializes in brass, bronze and aluminum castings, plumbing supply castings and general brass foundry work.

Rebuilding of the plant of the Monessen Foundry & Machine Co., Monessen, Pa., is under way, following a fire which recently destroyed three pattern storehouses and the core room. The operating end of the business was not damaged. The new pattern shop already is completed and ready for operation.

Increased brass foundry facilities are to be made by the American Ring Co., Waterbury, Conn., together with an expansion of its office space. As yet, exact details of the expansion have not been announced. The company recently increased its capital stock. Officers are: President, T. I. Driggs; vice president, F. E. Bartlett; secretary, W. W. Bowers, and assistant secretary, H. B. Jenkins.

The Portland Foundry Co., Portland, Conn., has purchased the John T. Young Co., Norwich, Conn., manufacturer of heaters. The Portland company has taken over the entire business with all rights, patents, trade marks and good will. The Portland company has been making castings for these furnaces for a number of years. Extensive alterations have been going on at the Portland foundry for many months, new equipment is being installed and it is expected that the capacity will be increased greatly within the next six months.

Phillips & Buttorff Mfg. Co., Nashville, Tenn., announce it is breaking ground for the erection of an additional building at its foundry plant. This structure, which is to be utilized for factory and warehouse purposes, will increase the company's production considerably. It will be 27 x 100 feet, 3-stories high, built of brick and mill construction with steel sash. The first floor will be used for the assembling of hot air furnaces.

New Trade Publications

METERS—The Connersville Blower Co., Connersville, Ind., is circulating a 4-page illustrated folder in which rotary displacement meters are described and illustrated. These meters measure both natural gas and artificial gas. Principles of operations are given.

FUEL EQUIPMENT—Quigley Fuel Systems Inc., 26 Cortlandt street, New York, recently issued an illustrated folder on pulverized fuel equipment. All these appliances are said to be dust tight. Some of those described are, a blow tank unit, switching valve, cyclone collector, distributing chute, stock tester gauge, dust tight gates, fuel feed controllers and powered coal burners.

FAN SYSTEMS—The B. F. Sturtevant Co., Boston, has published a 70-page illustrated booklet in which fan systems for collecting dust and conveying materials are described and illustrated. The booklet is divided into two sections, the first being devoted to describing apparatus used in collecting and conveying material, and the second containing data covering design and application of collecting systems. The illustrations are of actual installations.

ELECTRIC PORTABLE HOIST—A bulletin of the Northern Engineering Wroks, Detroit, describes and illustrates a ¼ to 1-ton electric portable hoist recently added to the line made by that company. This hoist can be adapted to either alternating or direct current, the standard alternating current being 60-cycles, 3-phase, 220 or 440 volts and the direct current 220 volts. Single speed control is used and the motors are of standard make. All gearing is inclosed, dustproof and arranged for internal lubrication. An automatic limit stop prevents the block from striking the hoist. A roller bearing trolley can be provided to suit various sized I-beams or bar tracks for short travel.